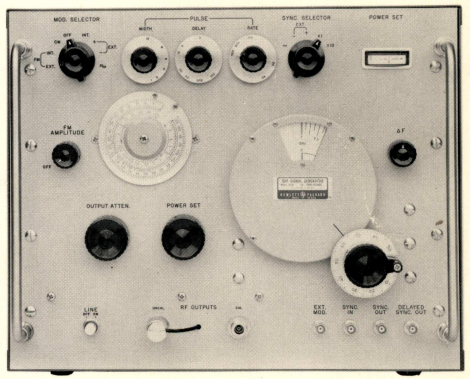
OPERATING AND SERVICE MANUAL

SHF SIGNAL GENERATOR

618C
620B



HEWLETT hp PACKARD

HP 618C/620B

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

MANUAL CHANGES

MANUAL IDENTIFICATION

Model Number: 618C/620B
Date Printed: May 1971
Part Number: 00618-90023

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections

Make all appropriate serial number related changes indicated in the tables below.

618C Serial Prefix or Number	Make Manual Changes
► 0979A-01766	1
► 1133A	2
► 1201A	3

620B Serial Prefix or Number	Make Manual Changes
►1134A	2
►1201A	3

► NEW ITEM

ERRATA

Appendix II Backdating:
Add to 618C and 620B backdating boxes:
Prefix 963-, make manual change K.

► CHANGE 1

Table 6-2, page 6-4,
R612 HP Part Number
Delete: 2100-0898.
Add: 2100-1772.

► CHANGE 2

Change figure 5-29 to new figure 5-29 enclosed.
Change figure 5-30 to new figure 5-30 enclosed.

Parts List:
Add C145 .22μf, 200 v.d.c. HP Part No. 0170-0038
Add R211 fxd, resistor 22M, ½W HP Part No. 0687-2261.
Under Miscellaneous add, "Cable, shielded HP Part No. 618B-16L.

► CHANGE 3

Page I-32, change to read:
00618-6056 Cabinet Assembly (Blue Gray).
Add: 00681-60099 Cabinet Assembly (Olive Gray).

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

15 December 1971

HEWLETT hp PACKARD

Printed in U.S.A.

CHANGE 3 (cont'd)

Page I-4, Item 51, change to read:
00618-620 Panel, Front (Light Gray).
00618-621 Panel, Front (Rack Mtg.) (Light Gray).

Add:
00618-60101 Panel, Front (Mint Gray).
00618-60102 Panel , Front (Rack Mtg.) (Mint Gray).

00620-620 Panel, Front (Light Gray).
00620-60031 Panel, Front (Mint Gray).

00620-621 Panel, Front (Rack Mtg.) (Light Gray).
00620-60032 Panel, Front (Rack Mtg.) (Mint Gray).

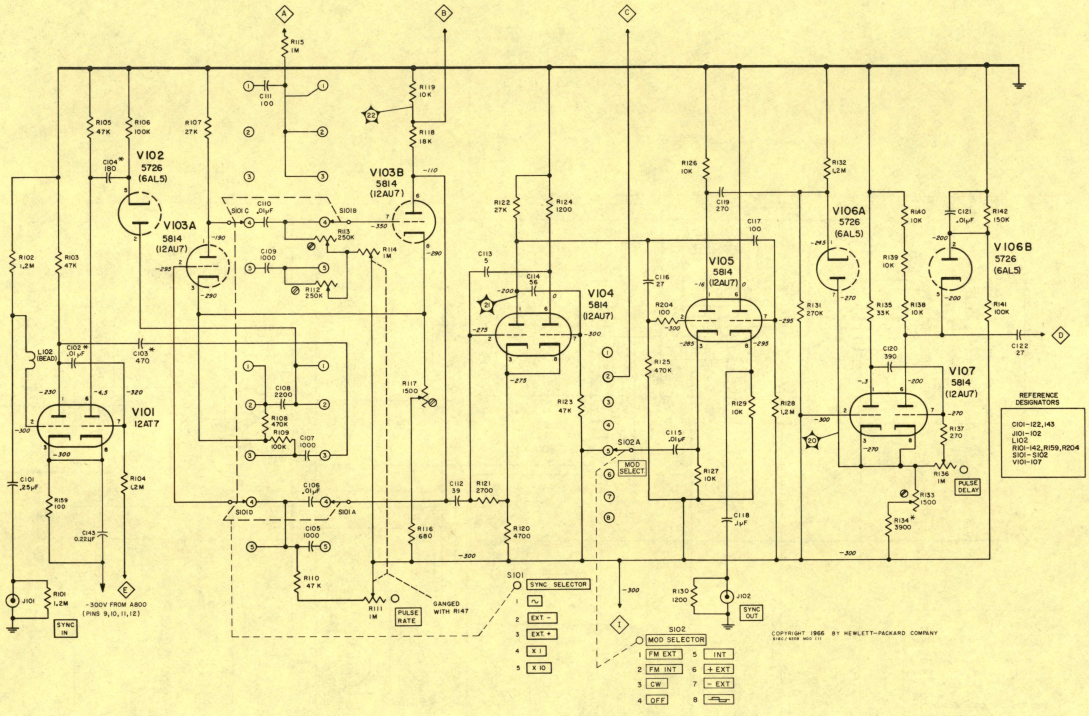


Figure 5-29. Modulator Section (Part 1 of 2)

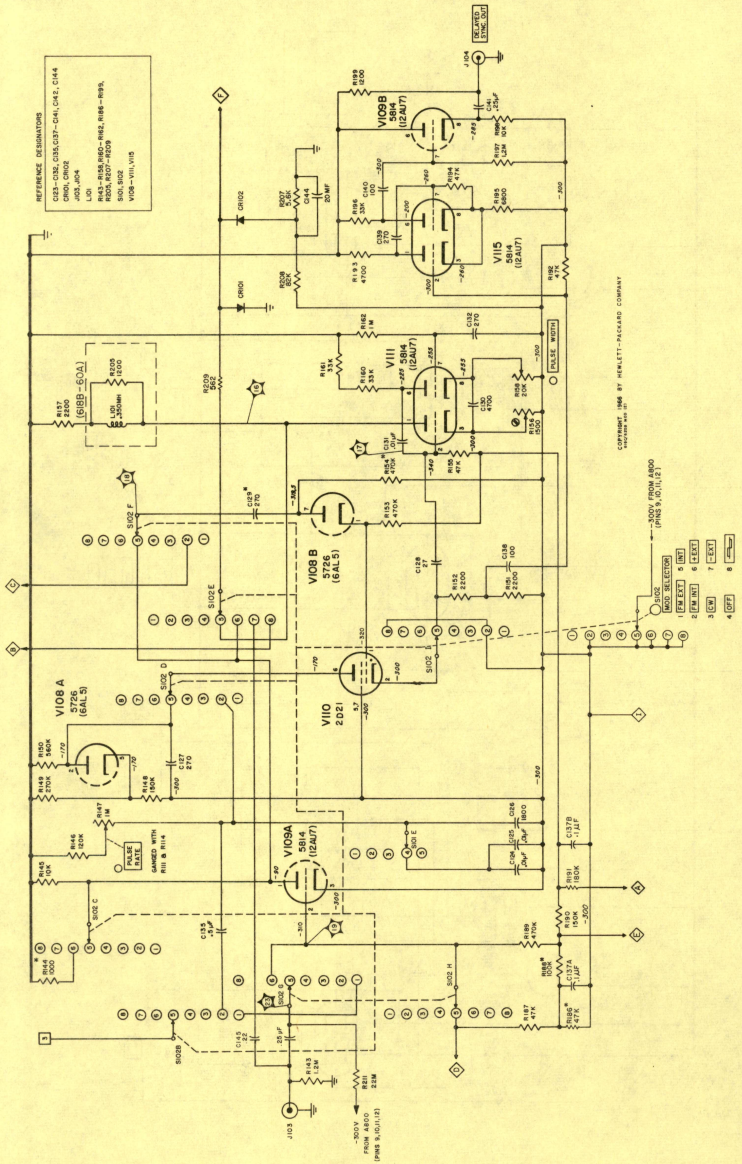


Figure 5-30. Modulator Section (Part 2 of 2)

MANUAL CHANGES

MANUAL IDENTIFICATION

Model Number: 618C/620B
Date Printed: May 1971
Part Number: 00618-90023

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections

Make all appropriate serial number related changes indicated in the tables below.

Serial Prefix or Number **618C**	Make Manual Changes
0979A01766 to 01780 1133A	1 1, 2
1201A	1, 2, 3
►1228A	1 thru 4

Serial Prefix or Number **620B**	Make Manual Changes
1134A	2
1201A	2, 3
►1231A	2, 3, 4

► NEW ITEM

ERRATA

Appendix II Backdating:
Add to 618C and 620B backdating boxes:
Prefix 963-, make manual change K.

Page 6-6, Table 6-2:
Change F101 HP Part No.,Description, Mfr Code and Part No. to: 2110-0338, Fuse 1.6 at 250V, 71400, MAX 1-6/10.

Change FL301 HP Part No. and Description to: 9110-2887, Filter RFI.

Page 6-7, Table 6-2:
Add: 1251-2357, Socket: 3-PIN MALE Power Receptable, 82389, EAC-301.

CHANGE 1

Table 6-2, page 6-4,
R612 HP Part Number
Delete: 2100-0898.
Add: 2100-1772.

CHANGE 2

Change figure 5-29 to new figure 5-29 enclosed.
Change figure 5-30 to new figure 5-30 enclosed.

Parts List:
Add C145 .22μf, 200 v.d.c. HP Part No. 0170-0038
Add R211 fxd, resistor 22M, ½W HP Part No. 0687-2261.
Under Miscellaneous add, "Cable, shielded HP Part No. 618B-16L.

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

July 24, 1972

HEWLETT hp PACKARD

Printed in U.S.A.

CHANGE 3

Page I-32, change to read:
00618-6056 Cabinet Assembly (Blue Gray).
Add: 00681-60099 Cabinet Assembly (Olive Gray).

Page I-4, Item 51, change to read:
00618-620 Panel, Front (Light Gray).
00618-621 Panel, Front (Rack Mtg.) (Light Gray).

Add:
00618-60101 Panel, Front (Mint Gray).
00618-60102 Panel , Front (Rack Mtg.) (Mint Gray).

00620-620 Panel, Front (Light Gray).
00620-60031 Panel, Front (Mint Gray).

00620-621 Panel, Front (Rack Mtg.) (Light Gray).
00620-60032 Panel, Front (Rack Mtg.) (Mint Gray).

►**CHANGE 4**

Page 5-37/5-38, Figure 5-31:
In the power transformer primary circuit, delete A800 and show the connection from the left side of B1 directly to transformer pin 3.

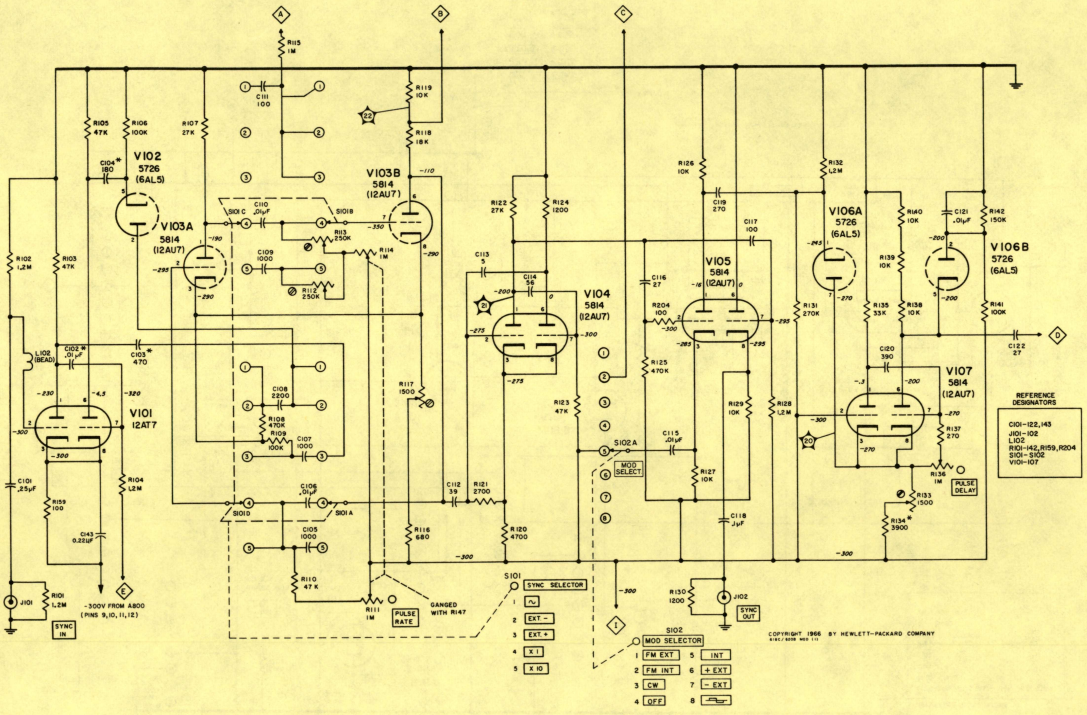


Figure 5-29. Modulator Section (Part 1 of 2)

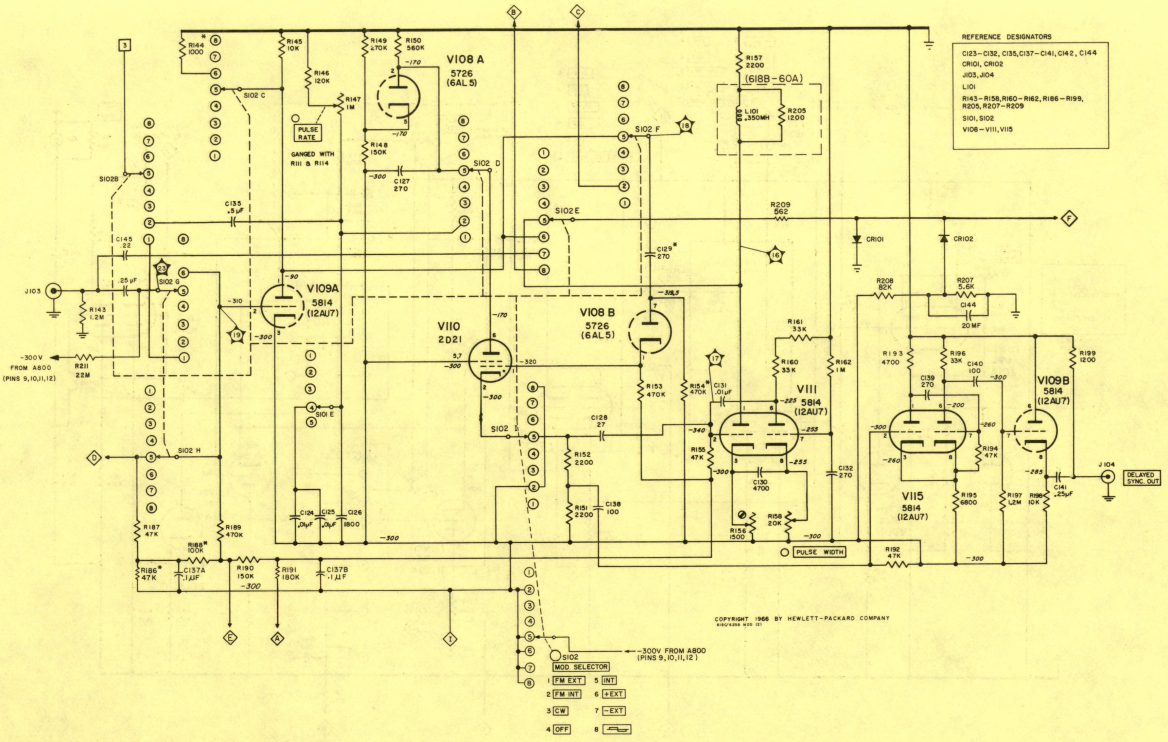


Figure 5-30. Modulator Section (Part 2 of 2)

SHF SIGNAL GENERATOR
618C AND 620B

SERIALS PREFIXED

618C: 979-, 0979A
620B: 985-, 0985A

This Operating and Service Manual applies directly to instruments bearing above serial prefixes.

SERIAL PREFIXES NOT LISTED

For instruments with higher serial number prefixes than above, refer to the enclosed MANUAL CHANGES supplement. For instruments with serial number prefixes lower than above, refer to Appendix II at rear of manual.

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Manual Part No. 00618-90023
Microfiche Part No. 00618-90024

Printed: MAY 1971

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Figure 1-1. Model 618C/620B SHF Signal Generators

SECTION I
GENERAL INFORMATION

1-1. DESCRIPTION.

1-2. The Hewlett-Packard Models 618C/620B SHF Signal Generators (Figure 1-1) provide RF signal output in the frequency ranges of 3800 to 7600 MHz, and 7000 to 11,000 MHz respectively. At least 1-mW power output is available over the entire frequency range. The output frequency is indicated on a direct-reading dial. The RF output power is adjustable by an attenuator that is calibrated in μV and dB.

1-3. Five types of modulation are available: internal pulse modulation, external pulse modulation, internal frequency modulation, external frequency modulation, and internal square-wave modulation.

1-4. The internal pulse modulation has a variable repetition rate of 40 to 4,000 Hz. Pulse width is variable from 0.5 to 10 μs as measured at the pulse 50% amplitude points. Internal square wave modulation is variable from 40 to 4,000 Hz.

1-5. The Signal Generator can be modulated by external pulses of positive or negative polarity. The amplitude of the modulating pulses may be 20 to 70V, and the pulse width between 0.5 and 2500 μs.

1-6. Internal frequency modulation comprises a sawtooth sweep rate of 40 to 4,000 Hz. Frequency deviation is variable from 0 to 5 MHz over most of the band. External frequency modulation from an external sine wave is provided. Frequency deviation is approximately 5 MHz.

1-7. Synchronization outputs of the Signal Generator comprise two types: delayed, and undelayed. The delayed synchronization output is a positive pulse that occurs simultaneous with the RF pulse. The pulse has an amplitude of 25 V minimum and a rise time less than 1 μs when terminated in a load of 1000 ohms or more. The undelayed synchronization pulse has the same characteristics as the delayed pulse, except the pulse occurs between 3 to 300 μs (as adjusted by front-panel control) before the RF pulse.

1-8. Both the pulse- and frequency-modulated RF output may be synchronized with the following externally generated signals: sine waves of 40 to 4,000 Hz, and 5 to 50V amplitude; pulses of 40 to 4,000 Hz, a peak amplitude of 5 to 50V, a rise time of 0.1 to 1 μs, and a width of 0.5 to 5 μs.

1-9. INSTRUMENT IDENTIFICATION.

1-10. Hewlett-Packard instruments have a two-part serial number. The first three digits are the serial prefix. If the prefix on your instrument is not listed on the title page of this manual, in the appendix, or on a Manual Change sheet enclosed with the manual, the correct information may be obtained from any Sales and Service Office listed at the rear of this manual.

1-11. KLYSTRON TUBE WARRANTY.

1-12. A klystron warranty claim has been included in this manual and is located at the rear of the Table of Replaceable Parts. When replacing a klystron tube which has failed prior to the expiration of the guarantee, fill out the claim sheet and return it with the tube to the company from which the tube was obtained. A new sheet will be furnished with each replacement tube purchased from Hewlett-Packard.

Table 1-1. Specifications

Output

Frequency Range:
618C: 3,800 to 7,600 MHz covered in a single band.
620B: 7 to 11 GHz covered in a single band.
Repeller voltage automatically tracked and proper mode automatically selected

Calibration: Direct reading. Frequency calibration accuracy better than ±1%.

Vernier: ΔF control has a minimum range of 0.5 MHz (618C), 1.5 MHz (620B) over most of the band for fine tuning. Remote ΔF connector on rear panel permits fine tuning with external potentiometer; tuning range at least 0.5 MHz (618C), 1.5 MHz (620B) over most of the band with potentiometer ≥ 2 megohms.

Frequency Stability:
With Temperature: Less than 0.006%/°C change in ambient temperature.
With Line Voltage: Less than 0.02% change for line voltage variation of ±10%.
Residual FM: < 15 kHz peak.

Output Range: 1 milliwatt or 0.224 volt to 0.1 microvolt (0 dBm to -127dBm) into 50 ohms. Directly calibrated in microvolts and dB. Coaxial Type N connector.

Output Accuracy: Within ±2 dB from -7 to -127 dBm, within ±3 dB from 0 to -7 dBm, at front panel connector, terminated in 50-ohm load. Temperature-compensated detector circuit monitors RF oscillator power level. An auxiliary, fixed-level RF output (at least 0.3 mW) is provided on the front panel for use with other equipment such as a frequency counter or phase-lock instrumentation.

Source Impedance: 50 ohms nominal; reflection coefficient less than 0.33 (2 SWR, 9.6 dB return loss.)

Modulation

Modulation: Internal or external pulse, FM, and square wave.

Internal Pulse Modulation: Repetition rate variable from 40 to 4,000 pps, pulse width variable 1/2 to 10 microseconds.

Sync Out Signals: Simultaneous with RF pulse, positive. In advance of RF pulse, positive, variable 3 to 300 microseconds. (Better than 1 microsecond rise time and 25 to 100 volts amplitude into 1,000-ohm load.)

External Synchronization:
Sine Wave: 40 to 4,000 Hz, 5 to 50 V rms.
Pulse: 40 to 4,000 pps, 5 to 50 V peak, positive or negative, 0.5 to 5 μsec wide, 0.1 to 1 μsec rise time.

Internal Square Wave Modulation: Variable, 40 to 4,000 Hz, controlled by PULSE RATE control.

Internal Frequency Modulation: Sawtooth sweep rate adjustable 40 to 4,000 Hz. Frequency deviation to 5 MHz peak-to-peak over most of the frequency range.

External Pulse Modulation: Pulse requirements: amplitude from 20 to 70 volts peak positive or negative, width 0.5 to 2,500 microseconds.

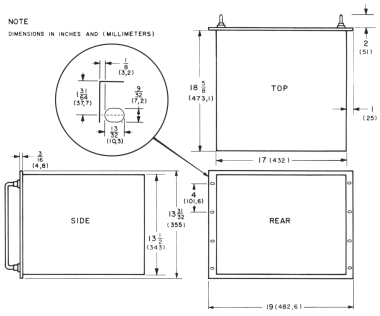
External FM: Frequency deviation approximately 5 MHz peak-to-peak over most of the band. Sensitivity approximately 20 V/MHz at front-panel connector, approximately 10 V/MHz at rear panel connector (mating connector supplied.) Front-panel connector is capacitively coupled to klystron repeller; rear-panel connector is dc coupled to klystron repeller and is suitable for phase-lock control input.

General

Power Source: 115 or 230 volts ±10%, 50 to 60 Hz, 230 W.

RFI: Conducted and radiated leakage limits are below those specified in MIL-I-6181D.

Dimensions: Cabinet Mount: 17-1/2 in. wide, 13-7/8 in. high, 20-3/8 in. deep behind panel (445 x 353 x 517 mm).
Rack Mount:



Weight: Net, 69 lbs. (31,1 kg). Shipping, 90 lbs. (40,5 kg).

Accessory Furnished: 11500A Cable Assembly, 6 feet (1830 mm) of specially treated RG-214A/U 50-ohm coaxial cable terminated at each end with UG-21D/U Type N male connectors; 7-1/2-ft. (2290 mm) power cable.

Accessories Available: 11001A Cable Assembly, 45 in. long, RG-58C/U 50-ohm Coax, terminated by dual banana connector on one end, BNC on other. 10503A Cable Assembly, 4 feet long, RG-58C/U 50-ohm Coax, terminated on each end by BNC male connectors.

SECTION II
INSTALLATION

2-1. INCOMING INSPECTION.

2-2. The Signal Generator was carefully inspected, both mechanically and electrically, prior to shipment. Inspect it for mechanical damage received in transit, check for supplied accessories, and test electrical performance using the procedure given in Section V. If there is damage or deficiency, or if electrical performance is not within specifications, see the warranty inside the front cover of this manual.

2-3. PREPARATION FOR USE.

2-4. POWER REQUIREMENTS.

2-5. The Signal Generator requires a power source of 115 or 230 V ac ±10%, single phase. The power source must supply approximately 250 W.

2-6. 115/230 VOLT OPERATION.

2-7. A two-position slide switch, on the rear panel, permits operation from either a 115 or 230 V power source. The number visible on the switch slider indicates the line voltage for which the Signal Generator is connected.

2-8. To prepare the Signal Generator for operation, set the 115-230 V switch so that the number visible on the slider corresponds to the available line voltage. Install a fuse of correct rating.

CAUTION

To avoid damage to the Signal Generator, before connecting the power cable, set the 115-230 V switch for the line voltage to be used.

2-9. POWER CABLE.

2-10. To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that the Signal Generator panel and cabinet be grounded. Accordingly, the Signal Generator is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the panel and cabinet. The offset pin of the three-prong connector is the ground pin.

2-11. To preserve the protection feature when operating the Signal Generator from a two-contact outlet, use a three-prong to two-prong adapter (HP Part No. 1251-0048) and connect the green pigtail on the adapter to ground.

2-12. COOLING.

2-13. Forced air cooling is used to maintain safe operating temperatures within the Signal Generator cabinet. The air intake and exhaust ports, cooling fan, and air filter are located at the rear of the cabinet. To ensure adequate ventilation, maintain about three inches of clearance behind the cabinet.

CAUTION

Do not operate the Signal Generator if the fan is not operational.

2-14. AIR FILTER.

2-15. The air filter, as received with a new Signal Generator, has a coating of dust-catching substance which improves air cleaning action. To maintain adequate ventilation, clean and recoat the air filter at regular intervals. See Section V for cleaning instructions.

2-16. REPACKING FOR SHIPMENT.

2-17. If the Signal Generator is to be packaged for shipment use the original shipping container and packing materials. If these have been discarded or not in condition for reuse, obtain new materials from your local Hewlett-Packard Sales and Service Office (see rear of this manual for locations), or follow these general instructions:

a. Wrap the Signal Generator in heavy paper or plastic. (If the Signal Generator is being shipped to a Hewlett-Packard service facility, attach a tag indicating type of servicing required, return address, model number, and full serial number.)

b. Use a strong shipping container. A carton made of 500- to 600-pound test material will usually provide adequate protection.

c. Use enough shock-absorbing material (3- to 4-inch layer) around all sides of instrument to provide firm cushion and prevent movement inside the container. Protect the control panel with cardboard. With Hewlett-Packard "floater pack" packaging, the foam blocks provide sufficient shock protection, and additional material is unnecessary.

d. Seal the shipping container securely.

e. Mark the shipping container "FRAGILE" to assure careful handling.

2-18. In any correspondence refer to the Signal Generator by model number and full serial number.

SECTION III
OPERATION

3-1. INTRODUCTION.

3-2. This section provides instruction to properly operate the Signal Generator. Included are general operating information; a description of controls, connectors, and indicators; and basic operating procedures for each mode of operation.

3-3. GENERAL OPERATING INFORMATION.

CAUTION

Do not connect RF or dc power in any magnitude to the output terminals of this instrument. As little as 0.2 W can permanently damage the attenuator probe. Extreme care should be exercised when working with transceiver-type equipment to insure that the transmitter section is not operating while the Model 618C/620B is connected to the transceiver antenna.

3-4. OUTPUT ACCURACY. The accuracy of the output system and the calibration of the attenuator in the Model 618C/620B is determined at the front-panel output jack. Output cable losses must be considered in addition to the attenuator dial indication when employing specific signal levels at the end of the output cable.

3-5. Erratic instrument performance at the output terminals, or no power output is frequently an indication that the instrument has been subjected to abuse. This condition may be confirmed by measuring either the dc resistance of the attenuator or the SWR looking into the panel connector. Dc resistance is approximately 50 ohms. SWR (at panel connector) is 2.0 or less.

3-6. The klystron used in this instrument is expensive and has a shorter life (approximately 1000 hours) than that of a conventional vacuum tube. Power should be removed from the Signal Generator when it is not in use in order to increase the useful life of the klystron.

3-7. CONTROLS, CONNECTORS AND INDICATORS.

3-8. Front-panel controls, connectors, and indicators are shown and described in Figure 3-1.

3-9. BASIC OPERATING PROCEDURES.

3-10. TURN ON.

a. Set rear-panel 115-230V switch to match line voltage, and check that the line fuse has correct rating.

b. Connect Signal Generator to power source.

c. Depress LINE switch. Allow 5-minute warmup time. If ambient temperature is below 10°C (50°F), allow a longer warmup period.

3-11. DETAILED OPERATING PROCEDURES.

CAUTION

Do not use the Signal Generator if the cooling fan does not operate at turn-on.

3-12. Detailed operating procedures are given in Figure 3-2 through 3-7.

3-13. OPERATION WITH THE DYMEC DY-2650A OSCILLATOR SYNCHRONIZER.

The 618C/620B is easily adapted for use with the DY-2650A Synchronizer as follows:

1. Remove the internal shorting jumper from J303, pins A & B. Refer to Figure 5-22. The jumper is connected between the klystron reflector and its power supply across R526.
2. Connect the mating connector J7 to P2 on the DY-2650A. This is to protect a user from accidentally contacting the otherwise exposed pins of P2, one of which will be at the reflector potential after completion of step 3.
3. Connect the klystron reflector lead and the reflector voltage lead to pins G and F, respectively, of J5 on the DY-2650A. An RG-59A/U type cable is recommended for this connection.

No other modifications are normally required. The RF sample for the DY-2650A must be obtained from the signal generator output connector through a suitable coupler. Varying the output level from the signal generator to the device being tested will also vary the RF sample level into the DY-2650A. It is therefore necessary to set the RF output level from the signal generator to a fixed value and to use an external attenuator for varying the level to the device under test if wide ranges in level are required.

CAUTION

When the shorting jumper has been removed from the klystron reflector supply voltage as described in step 1 above, the 620B must not be operated without being connected to the DY-2650A unless the reflector lead jumper is replaced. Omission of the jumper will damage the klystron.

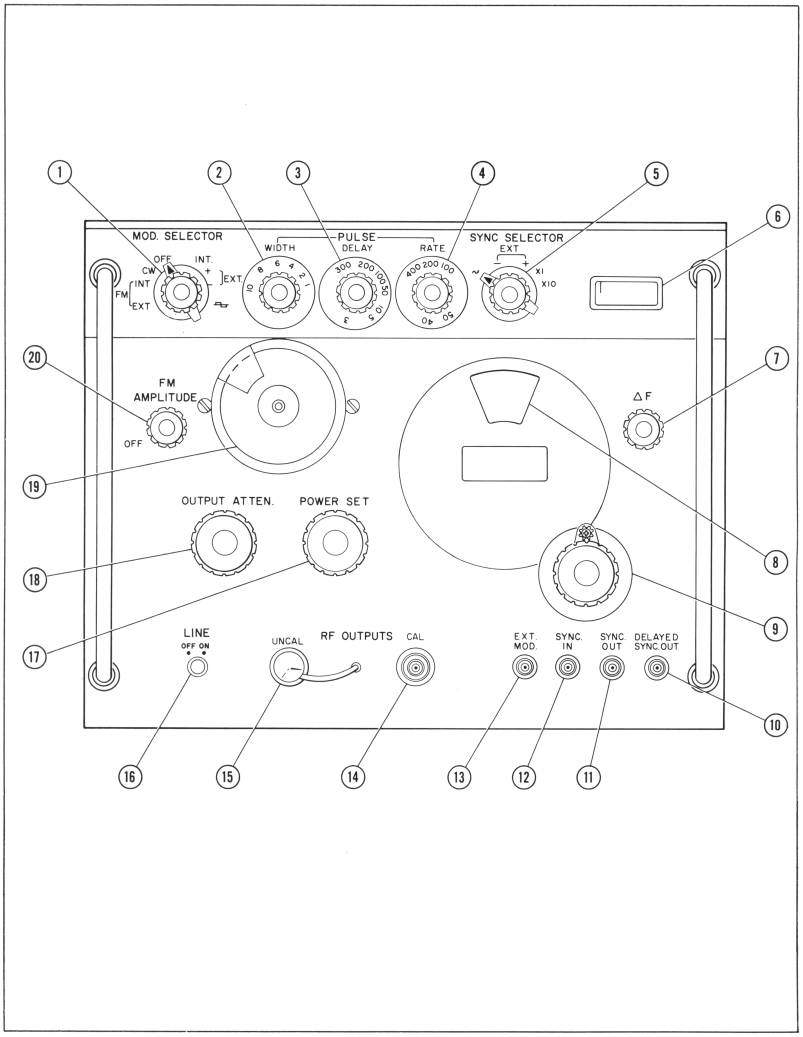
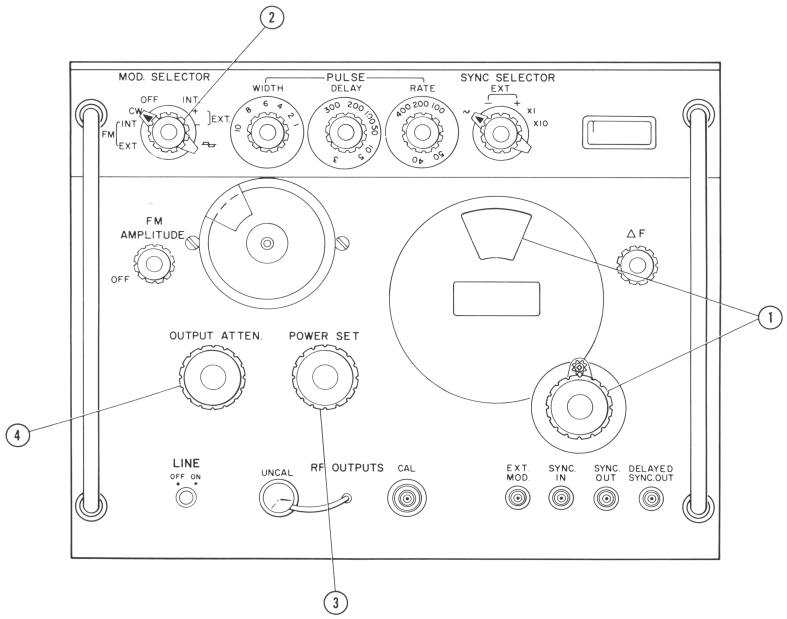


Figure 3-1. Front-panel Controls, Connectors, and Indicators (Part 1 of 2)

1. MOD. SELECTOR. In FM EXT position, sine wave or sawtooth applied to EXT. MOD connector modulates Signal Generator. In FM INT position, an internally generated sawtooth modulates the Signal Generator. In CW position, the Signal Generator is not modulated. In OFF position, Signal Generator RF output is disabled. In INT. position, the Signal Generator is modulated by internally generated pulses. In EXT+ position, the Signal Generator can be modulated by positive pulses applied to the EXT. MOD. connector. In EXT- position, the Signal Generator can be modulated by negative pulses applied to the EXT. MOD. connector. In ⊓⊔ position Signal Generator is modulated by internally generated square waves (approximately 50% duty cycle).
2. PULSE WIDTH. Adjusts width of modulating pulse when MOD. SELECTOR is set to INT.
3. PULSE DELAY. Adjusts the delay time between synchronizing pulse and RF output pulse from 3 to 300 μs.
4. PULSE RATE. Adjusts pulse repetition rate of modulation when MOD SELECTOR is set to INT. FM INT, or ⊓⊔ position and SYNC SELECTOR is in X1 or X10 position. When SYNC SELECTOR is in X1 position, pulse rate is indicated by PULSE RATE control; when SYNC SELECTOR is in X10 position, pulse rate is 10 times that indicated by PULSE RATE control.
5. SYNC SELECTOR. In ~ position, and when MOD. SELECTOR is set to INT, Signal Generator may be synchronized by external sine-wave signal of 5-50 V rms applied to SYNC. IN connector. In EXT- position, and when MOD. SELECTOR is in INT position, Signal Generator must be synchronized by negative pulses (5-50 V peak-to-peak) applied to SYNC. IN connector. In EXT+ position, and when MOD. SELECTOR is set to INT, the Signal Generator must be synchronized by external positive pulses (5-50 V peak-to-peak) applied to the SYNC. IN connector. In X1 position, and MOD. SELECTOR is set to INT, the modulation repetition rate is as indicated by the PULSE RATE control. In the X10 position, and when MOD. SELECTOR is set for INT, the modulation repetition rate is 10 times that indicated by the PULSE RATE control.
6. Power Meter. Indicates RF power input in dBm to attenuator.
7. ΔF. Provides up to 0.5 MHz adjustment of output frequency for 618C; 1.5 MHz for 620B.
8. MHz/GHz. Indicates RF output frequency in megahertz/gigahertz for 618C/620B respectively.
9. Frequency Control. Adjusts RF output frequency.
10. DELAYED SYNC. OUT. Delayed (3-300 μs) synchronization signal is available at this connector.
11. SYNC. OUT. Undelayed synchronization output signal is available at this connector.
12. SYNC. IN. External synchronization signal is applied to this connector.
13. EXT. MOD. External modulation signal is applied to his connector.
14. RF OUTPUTS CAL. Source of calibrated RF power is available at this connector.
15. RF OUTPUTS UNCAL. Uncalibrated RF output power is available at this connector.
16. LINE. Turns Signal Generator on and off.
17. POWER SET. Adjusts RF power input to attenuator.
18. OUTPUT ATTEN. Adjusts RF output power to a calibrated level.
19. Attenuator Dial. Indicates RF output level when power meter is indicating 0.
20. FM AMPLITUDE. Adjusts frequency deviation of RF when using frequency modulation.

Figure 3-1. Front-Panel Controls, Connectors, and Indicators (Part 2 of 2)



Note

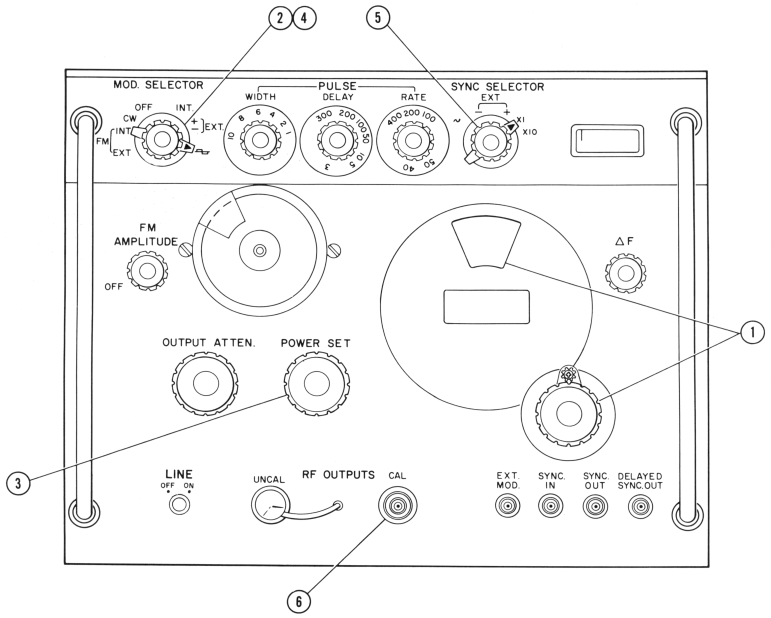
Perform turn-on procedure described in paragraph 3-10.

1. Adjust frequency control for desired RF output frequency as indicated on dial. ΔF is vernier turning which can be adjusted by the knob on the front panel or by varying a potentiometer connected to the ΔF connector on the rear (see specifications).
2. Set MOD. SELECTOR to CW.
3. Adjust POWER SET for 0 indication on power meter.
4. Adjust OUTPUT ATTEN. for desired output level as indicated by attenuator dial.

Note

ΔF control should be centered when not in use.

Figure 3-2. CW Operation



Note

Perform turn-on procedure described in paragraph 3-10.

1. Adjust frequency control for desired RF output frequency as indicated on dial.
2. Set MOD. SELECTOR to CW.
3. Adjust POWER SET for 0 indication on power meter.
4. Set MOD. SELECTOR TO ⊓⊔.
5. Set SYNC SELECTOR TO X1 or X10 and adjust PULSE RATE control for desired square-wave frequency.
6. Connect RF cable between RF OUTPUTS CAL. connector and equipment being tested.

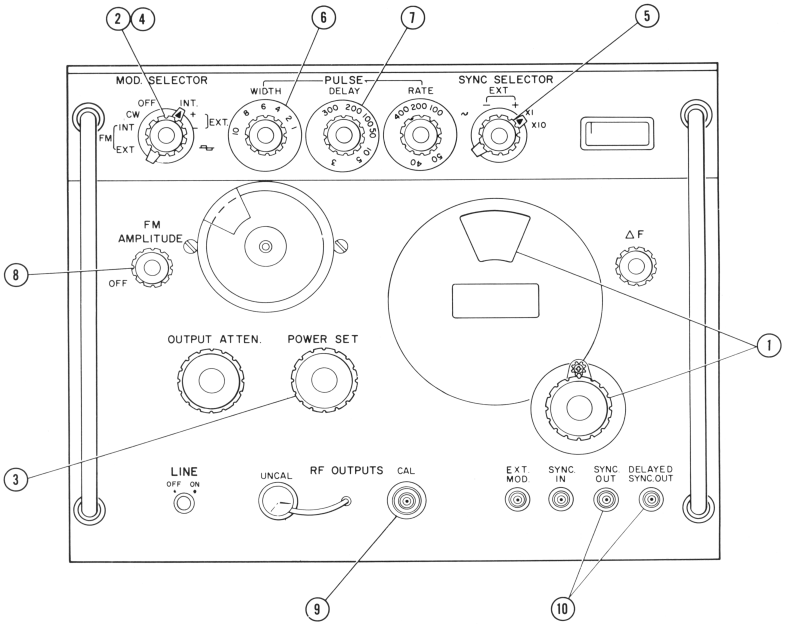
Note

Synchronization pulses occurring at the modulation rate are available at the SYNC. OUT connector.

Note

ΔF control should be centered when not in use.

Figure 3-3. Internal Square-Wave Modulation Operation



Note

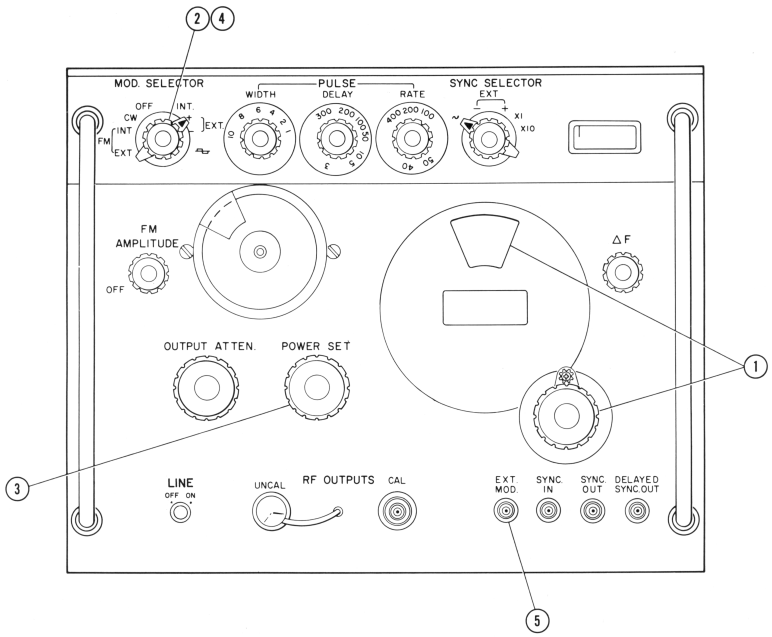
Perform turn-on procedure described in paragraph 3-10.

1. Adjust frequency control for desired RF output frequency as indicated on dial.
2. Set MOD. SELECTOR to CW.
3. Adjust POWER SET for 0 indication on power meter.
4. Set MOD. SELECTOR to INT.
5. Set SYNC SELECTOR to X1 or X10, and adjust PULSE RATE control for desired pulse repetition rate.
6. Adjust PULSE WIDTH control for desired modulation pulse width.
7. Adjust PULSE DELAY control for desired delay time.
8. Set FM AMPLITUDE control to OFF.
9. Connect RF cable between RF OUTPUTS CAL connector and equipment being tested.
10. Connect pulse cable between the SYNC OUT and/or DELAYED SYNC OUT connectors and external equipment as required by the application.

Note

ΔF control should be centered to obtain optimum pulse rise and decay.

Figure 3-4. Internal Pulse Modulation Operation



Note

Perform turn-on procedure described in paragraph 3-10.

1. Adjust frequency control for desired RF output frequency as indicated on dial.
2. Set MOD. SELECTOR to CW.
3. Adjust POWER SET for 0 indication on power meter.
4. Set MOD. SELECTOR to EXT or EXT-, as required by the polarity of the external modulating pulses.
5. Connect external modulating source to EXT. MOD. connector. External modulating pulses must have peak-to-peak amplitude of between 20 and 70V.

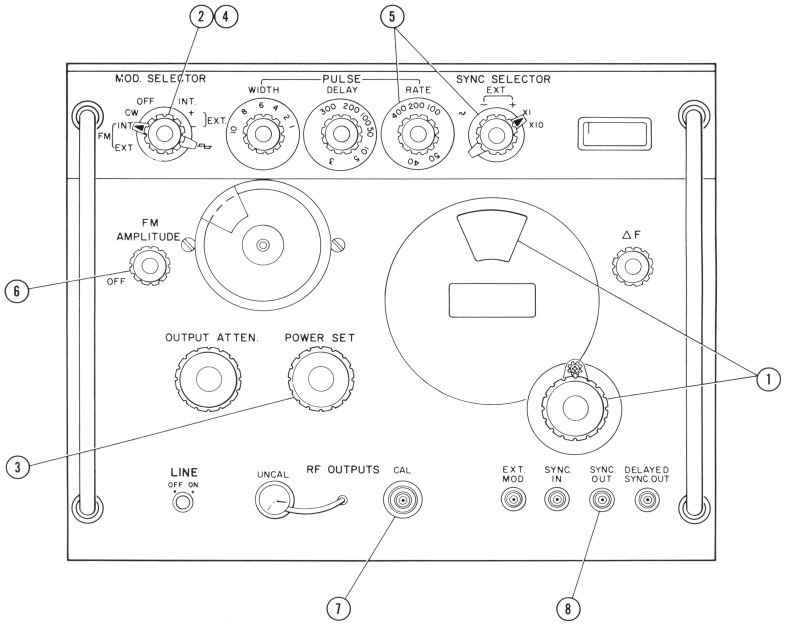
Note

In this mode of operation, no synchronization pulses are available at the DELAYED SYNC. OUT or SYNC. OUT connector.

Note

ΔF control should be centered to obtain optimum pulse rise and decay.

Figure 3-5. External Pulse Modulation Operation



Note

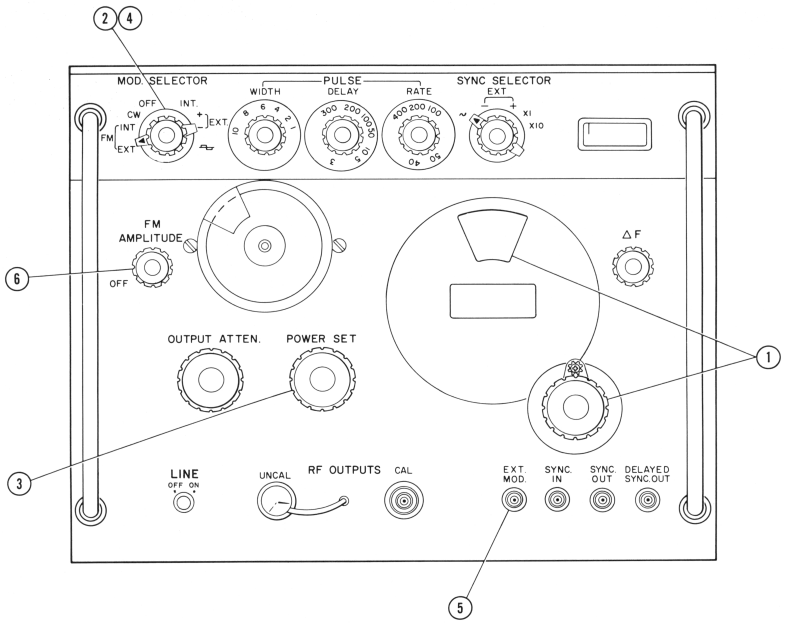
Perform turn-on procedure described in paragraph 3-10.

1. Adjust frequency control for desired RF output frequency as indicated on dial.
2. Set MOD. SELECTOR to CW.
3. Adjust POWER SET for 0 indication on power meter.
4. Set MOD. SELECTOR to FM INT.
5. Set SYNC SELECTOR to X1 or X10 and adjust PULSE RATE control for desired modulation frequency.
6. Set FM AMPLITUDE to OFF, and then carefully turn the control clockwise until the desired degree of frequency deviation is obtained. Because of klystron characteristics, unstable operation will occur when the control has been advanced to the point where the FM deviation is greater than the stable portion of the mode.
7. Connect RF cable between RF OUTPUTS CAL connector and equipment under test.
8. If desired, connect pulse cable between SYNC. OUT. CONNECTOR and external equipment.

Note

ΔF control should be centered to allow the klystron to operate in the center of the mode.

Figure 3-6. Internal Frequency Modulation Operation



Note

Perform turn-on procedure described in paragraph 3-10.

1. Adjust frequency control for desired RF output frequency as indicated on dial.
2. Set MOD. SELECTOR to CW.
3. Adjust POWER SET for 0 indication on power meter.
4. Set MOD SELECTOR to FM EXT.
5. Connect external modulation voltage to the EXT. MOD. connector. The modulation signal should have a level of at least 70 V rms.
6. Set FM AMPLITUDE to OFF, and then carefully turn the control clockwise until the desired degree of frequency deviation is obtained. Because of klystron characteristics, unstable operation will occur when the control has been advanced to the point where the FM deviation is greater than the stable portion of the mode.

Note

In this mode of operation, no synchronization pulses are available at the DELAYED SYNC. OUT or SYNC. OUT connector.

Note

ΔF control should be centered to allow the klystron to operate in the center of the mode.

Figure 3-7. External Frequency Modulation Operation

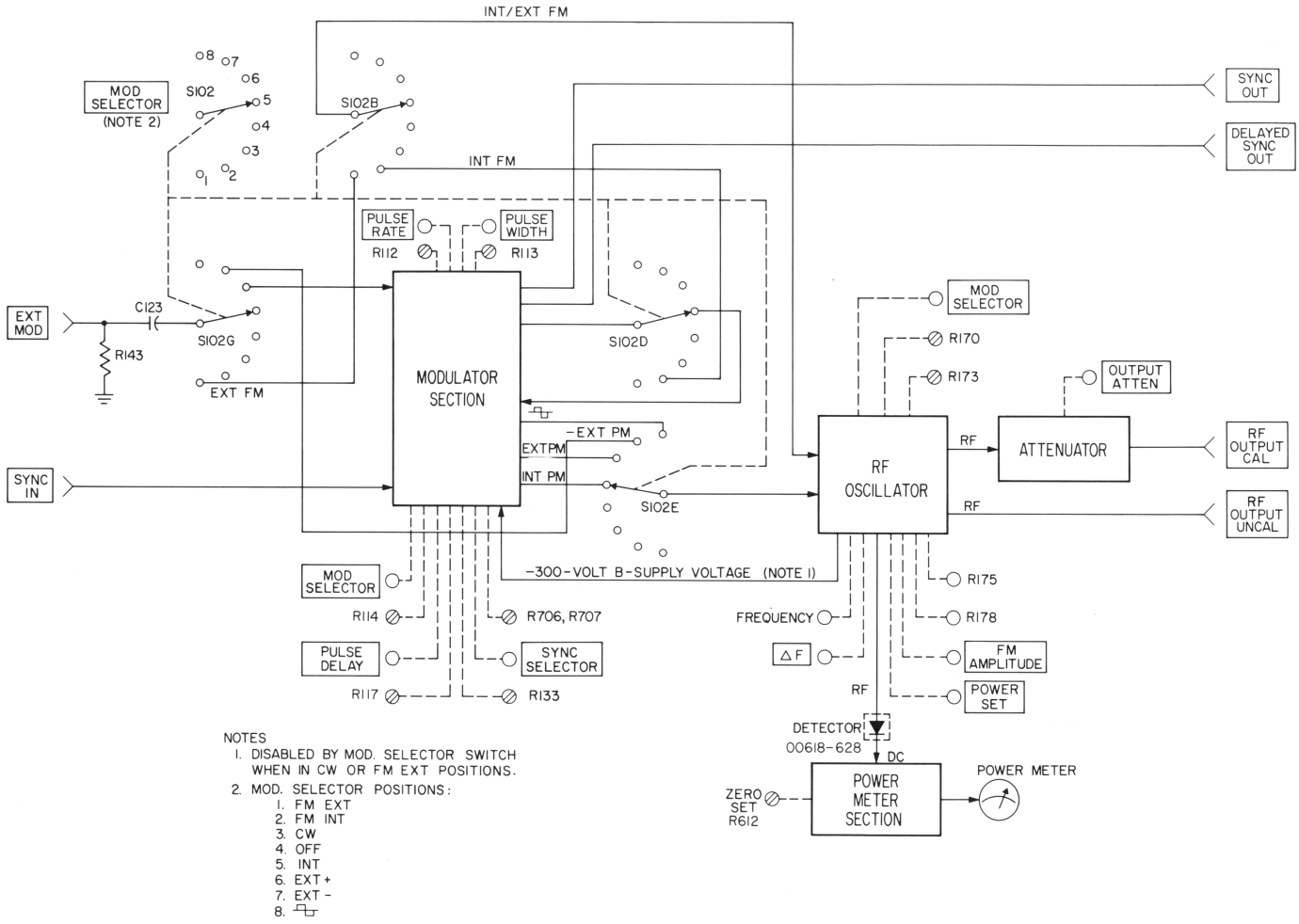


Figure 4-1. Simplified Block Diagram

SECTION IV
PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. This section contains explanations of the operation of the Signal Generator circuits. Figure 4-1 is a simplified block diagram showing principal circuit sections and operating controls. Each circuit section and important individual circuits are explained in succeeding paragraphs.

4-3. THE MODULATOR SECTION.

4-4. The Modulator Section is shown in block diagram form in Figure 4-2. The function of the circuits in this section is to establish a modulating pulse (for pulse operation) or a sawtooth voltage (for frequency modulation) and to apply it to the RF oscillator to obtain the desired type of RF output. Various portions of these circuits are not employed in certain types of operation, such as external pulse or external FM operation (see Figure 4-1). However, the block diagram shows the condition (delayed pulse output with external synchronization) where all of the circuits are employed, and the description will cover this type of operation. Other types of operation will be described in later paragraphs.

4-5. SYNCHRONIZING CIRCUITS. These circuits accept the external synchronizing voltage applied at the SYNC IN connector, and transform it into a negative pulse to trigger Pulse Rate Multivibrator V103. The circuit elements are shown in Figure 4-3. The grid of V101A is returned to B+ (ground). This places the grid at zero bias and the tube is conducting through plate load resistor R103. The tube responds to both positive and negative signals.

4-6. The negative-going portion of a sine-wave synchronizing voltage, or a negative synchronization pulse, causes the tube to cut off, developing a positive pulse in its plate circuit. This pulse is applied to the grid of V101B. Tube V101B is cut off (bias of -15 V) and the positive pulse from the plate of V101A causes V101B to conduct; thus, its plate voltage drops and the output is a negative-going pulse with a steep leading edge.

4-7. This negative pulse is applied to the ~ and (-) contacts of SYNC SELECTOR switch S101A through Series Clipper V102A. Clipper V102A develops only negative pulses at its output.

4-8. When a positive external synchronization pulse is applied to the grid of V101A, a negative pulse is developed in its plate circuit and applied through capacitor C103 to the + contact of S101A.

4-9. PULSE RATE MULTIVIBRATOR, SYNC CONDITION. When external sine-wave synchronization signals are employed, the Synchronization Multivibrator is switched to the operating condition shown in Figure 4-4. This circuit is a one-shot multivibrator, with V103A drawing current while V103B is cut off. The negative pulse from the synchronization input circuits causes the multivibrator to switch at t_1, developing a negative pulse in the plate circuit of V103B. The width of the pulse is determined by the length of time required to discharge capacitor C111 through resistor R115.

4-10. PULSE RATE MULTIVIBRATOR, FREE-RUNNING CONDITION. In the FM INT, INT (pulse), and ⊓⊔ positions of MOD. SELECTOR switch S102, the Pulse Rate Multivibrator is converted to a free-running multivibrator (Figure 4-5). Under this condition the synchronization input circuits are disconnected from the multivibrator.

4-11. The time constants of the multivibrator are balanced so that the circuit generates a wave that is essentially square with approximately a 50% duty cycle; however, this may vary depending upon the repetition rate. This arrangement is used so that internal square-wave as well as internal pulse modulation of the RF Oscillator can be obtained. The arrangement also provides for equally spaced pulses to trigger the Sawtooth Generator when internal FM modulation is being used.

4-12. PULSE SHAPER. The Pulse Shaper (Figure 4-6) is a One-Shot Multivibrator with a 2-μs pulse duration. It consists of V104A and V104B, two halves of type 5814A dual triode. In the steady-state condition, V104A is conducting as its grid is returned to the cathode by resistor R121. Tube V104B is cut off as its grid is returned to -300V, thus placing a bias on the grid (developed by the current through V104A and cathode resistor R120).

4-13. When this multivibrator is triggered by the negative-going leading edge of the waveform generated by the Pulse Multivibrator, a positive 2-μs pulse appears at the plate of V104A.

4-14. The positive output pulse is applied to the Synchronization Amplifier tube, V105A, shown in Figure 4-7, and to Synchronization Cathode Follower V105B, shown in Figure 4-6.

4-15. SYNCHRONIZATION CATHODE FOLLOWER. This stage provides the undelayed synchronization output signal for synchronizing external equipment. It is comprised of V105B, one half of a type 5814 dual-triode tube. The output is taken across R129, the cathode resistor, and is capacitively coupled through C118 to the SYNC. OUT connector. Resistor R130 is returned from the center conductor of the connector to ground, so that the line is terminated in reference to ground instead of the -300V potential existing at the base of the cathode resistor.

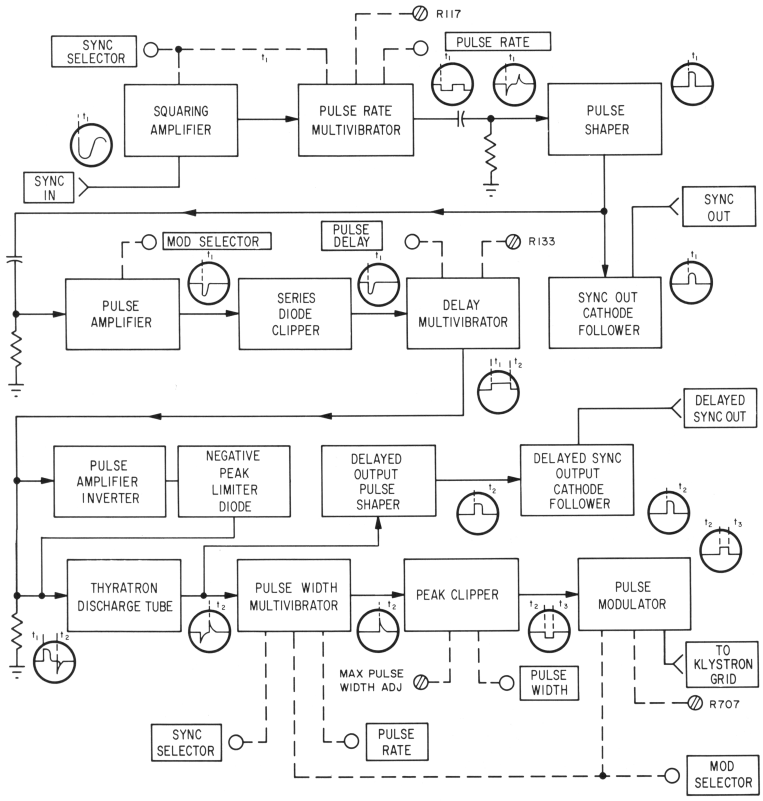


Figure 4-2. Modulator Section Block Diagram

4-16. The output of the Cathode Follower is a positive pulse greater than 25 V peak-to-peak when applied to a load having a resistance of from 1000 to 100,000 ohms and a shunt capacitance of 500 pF.

4-17. PULSE AMPLIFIER. The Pulse Amplifier is comprised of V105A, one-half of a type 12AU7 tube (Figure 4-7), and its associated components. It amplifies and inverts the 2 μs pulse provided by the Pulse Shaper and provides a positive pulse (in its cathode circuit) that is employed to trigger the Sawtooth Generator when internal frequency modulation is employed. Capacitor C115 acts as a cathode bypass capacitor when internal pulse modulation is used.

4-18. SERIES LIMITER. The negative pulse from the plate of the Pulse Amplifier is applied to the cathode of diode limiter V106A (Figure 4-7). This limiter is so connected that only the negative components with an amplitude greater than the diode bias are applied to the cathode of the Delay Multivibrator. This prevents triggering the multivibrator by any positive or low-amplitude negative transients that may appear on the output of V105A in addition to the desired trigger pulse.

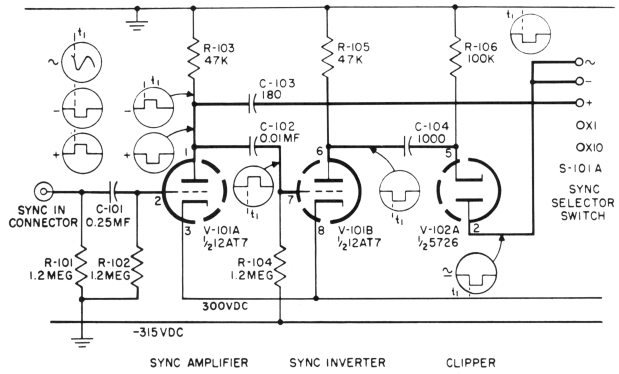


Figure 4-3. Schematic Diagram of Synchronizing Circuits

4-19. DELAY MULTIVIBRATOR. This circuit (Figure 4-7) provides an adjustable time delay in applying the modulation to the RF Oscillator. It consists of a type 12AU7 dual triode, V107, connected as a one-shot multivibrator with an adjustable resistor R136, the PULSE DELAY control.

4-20. The Delay Multivibrator starts its cycle when a negative pulse drives the cathode of V107A in a negative direction. This is equivalent to placing a positive signal on the grid, and the tube conducts. A negative wave-front appears at the plate of V107A and (through capacitor C120) drives the grid of V107B in a negative direction, cutting off this half of the stage. The length of time the circuit requires to return to its resting condition is determined by the time constant of C120, R136 and R137. Potentiometer R136 is the PULSE DELAY control that adjusts the delay from 3 to 300 μs while Potentiometer R133 is an adjustment used to set the maximum delay to 300 μs.

4-21. In the steady-state condition V107A is cut off while V107B is conducting through plate load resistors R138, R139 and R140, in parallel with resistor R142 and diode V106B.

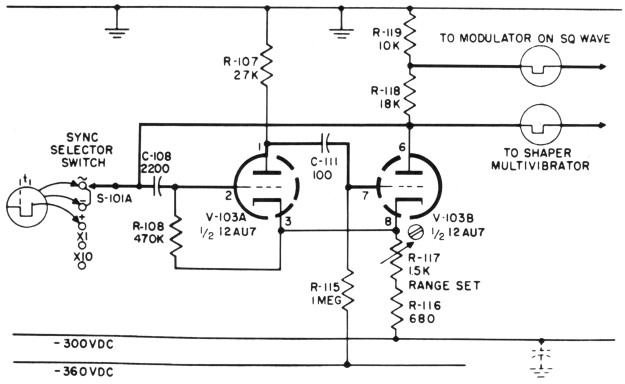


Figure 4-4. Schematic of Pulse-Rate Multivibrator, Synchronized Condition

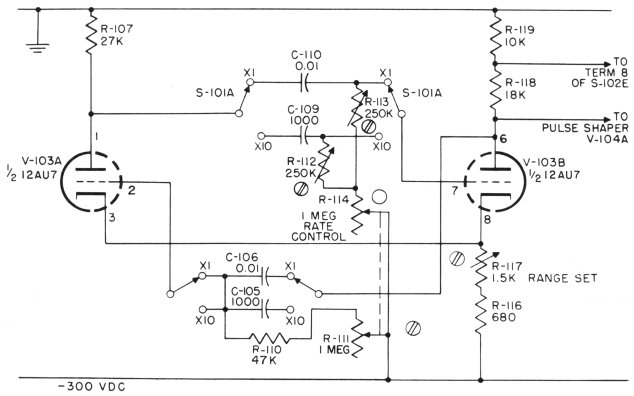


Figure 4-5. Schematic of Pulse-Rate Multivibrator Free-Running Condition

4-22. Tube V106B serves as a negative base limiter to eliminate low-amplitude negative pulses that may otherwise follow the trailing edge of the main pulse from V107B.

4-23. PULSE AMPLIFIER INVERTER. This stage (Figure 4-8) is comprised of V109A, one-half of a type 12AU7 dual triode. The positive pulse from the Pulse Delay Multivibrator is differentiated by capacitor C122 and resistor R187 to form a sharp negative spike at t_2. These spike pulses are amplified and inverted in the plate circuit of V109A.

4-24. BLOCKING DIODE. The output of V109A is applied to the grid of Thyratron Discharge tube V110 through blocking diode V108B. Tube V108B serves to pass the positive output spike at t_2 and to inhibit the negative spike at t_1. At short delay times, this insures positive triggering of Thyratron V110.

4-25. THYRATRON DISCHARGE TUBE. This stage consists of the type 2D21 thyratron tube, V110, shown in Figure 4-8. Its grid is returned to approximately -315 V while the cathode is returned to -300 V, cutting off the tube. Capacitor C127 is charged to approximately 110 V positive with respect to the cathode, a point established by the values of resistors R148, R149, and Diode V108A. This limiting of the voltage on capacitor C127 is necessary due to wide variation in the

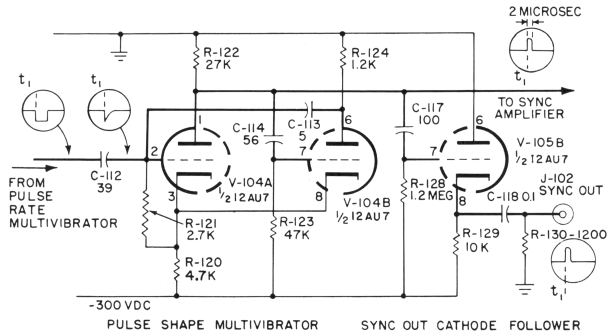


Figure 4-6. Schematic of Pulse Shaper

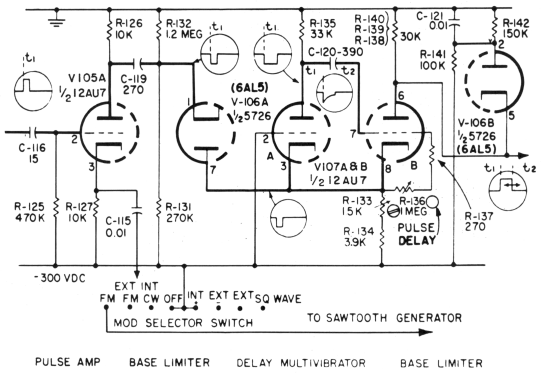


Figure 4-7. Schematic of Pulse Amplifier and Delay Multivibrator

pulse repetition frequency and the fact that the capacitor charges exponentially with time. Otherwise, the capacitor would charge to a higher potential at the low repetition frequencies than at the high frequencies. The Diode, V108A, limits the charge of C127 to a value that can be reached at the highest repetition frequencies, and prevents it from going higher regardless of the charging time available.

4-26. When the positive pulse from V109A is applied to the grid, the tube ionizes and capacitor C127 discharges through the tube and cathode resistors R151 and R152. This causes a positive pulse to appear across the cathode resistors. When capacitor C127 is nearly discharged and the plate voltage is at a very low value, the tube deionizes and returns to the resting condition. By this time the pulse on the grid has

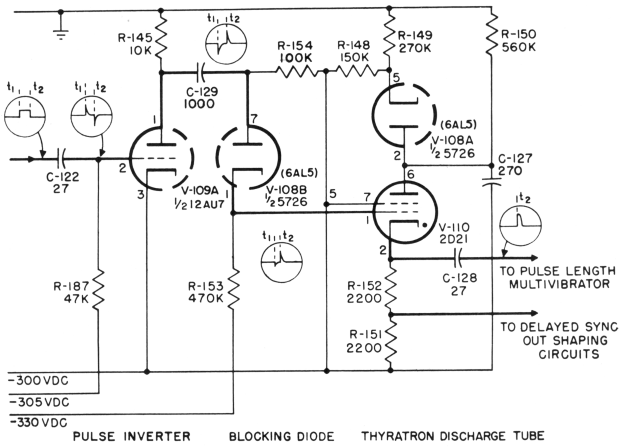


Figure 4-8. Schematic of Thyratron Discharge Circuits

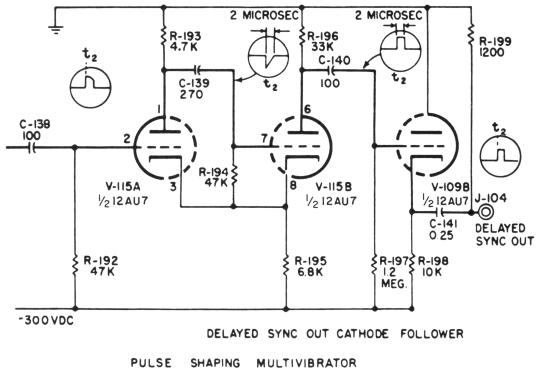


Figure 4-9. Schematic of Pulse-Shaping Multivibrator and Delayed Synchronization Cathode Follower

decayed and the grid bias is again -315 V. Capacitor C127 is rapidly recharged to its resting voltage of approximately 100 V and is maintained at this value through the action of the Diode circuit, V108A, previously explained. The spike pulse occurring in the cathode circuit at t_2 is applied to the Pulse Length Multivibrator and to the delayed synchronization pulse output circuits.

4-27. DELAYED-OUTPUT PULSE SHAPER AND CATHODE FOLLOWER. The Delayed Output Pulse Shaper (Figure 4-9) is a multivibrator comprised of the two triode sections of a type 12AU7 tube, V115. One half of another 12AU7 dual triode tube, V109B, is connected as a Cathode Follower. The positive spike developed in the cathode circuit of the Thyratron Discharge Tube is applied to grid of V115A through capacitor C138 at time t_2. The section of the multivibrator formed by V115A is cut off, its negative bias being established by the current through cathode resistor R195.

4-28. The section comprised of V115B is conducting in the resting condition as its grid is returned to the cathode through resistor R194. The positive leading edge of the pulse from V110 causes the multivibrator to switch, cutting off current through V115B and causing the voltage at its plate to rise.

4-29. The time constant of the circuit is approximately 2-μs. At the end of this time, capacitor C139 is discharged (through resistors R194 and R195) to a point where V115B again conducts and completes the cycle. The output at the plate of V115B is a positive pulse of 2-μs duration. This pulse is coupled to V109B, the Cathode Follower.

4-30. Tube V109B is employed as an impedance transformer, receiving the pulse from the high-impedance plate circuit of the multivibrator and delivering it to the relatively low impedance across the DELAYED SYNC. OUT connector for synchronizing external equipment.

4-31. PULSE-LENGTH MULTIVIBRATOR. The Pulse Length Multivibrator (Figure 4-10) is a one-shot multivibrator employing a type 12AU7 tube, V111. The circuit employs capacitive cathode-to-cathode coupling to secure the positive feedback action. This avoids any feedback connection to the plate of V111A, reducing stray capacitance that would tend to degrade the voltage rise and fall times. Peaking inductance L101 is also employed in the plate circuit to further steepen the wave form.

4-32. The section comprised of V111A is cut off since a bias of -30 V is applied to its grid. This places the V111A side of capacitor C130 at a potential of -300 V. The second section is at saturation because its grid

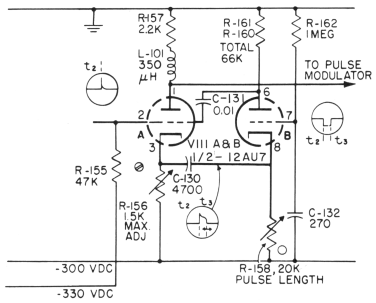


Figure 4-10. Schematic of Pulse-Length Multivibrator

is connected to the positive supply point (ground) through resistor R162. As a result, the other side of capacitor C130 is at a relatively higher potential due to the drop across resistor R158.

4-33. When the positive pulse at t_2 is applied to the grid of V111A, V111A immediately conducts, causing the V111A side of capacitor C130 to rise to the potential established by the current through resistor R156; thus, resistor R156 acts as a maximum delay-time adjustment for the circuit.

4-34. The voltage rise across resistor R156 is applied to the cathode of V111B, causing it to become more positive with respect to its control grid. This cuts off the tube rapidly, since the grid is maintained at the cathode potential by the time constant of R162 and C132.

4-35. Capacitor C130 is now charged and commences to discharge. The time required to discharge to a point where V111B again conducts determines the duration of the negative output pulse. The width is adjusted by R158, the PULSE WIDTH control. This control can be adjusted to provide pulses between 0.5 and 10 μs. The output of the Pulse Length Multivibrator is a negative pulse, starting at t_2 and ending at t_3. Diodes CR101, CR102 serve to limit the negative pulse to approximately 10 V peak-to-peak. The limited pulse is applied to Klystron Modulator tube V701.

4-36. KLYSTRON MODULATOR (618C). The Klystron Modulator (Figure 4-11) is comprised of tube V701 and associated parts. The modulation pulse is applied through capacitor C701 to the grid of V701. The output of the Klystron Modulator is developed across plate resistors R703 and R705. Diode CR703 serves as a clipper to limit the amplitude of the pulse applied to the Klystron. When the pulse at the plate of V701 is more positive than the voltage present at the cathode of CR703, the diode conducts and limits the pulse. The voltage at which CR703 conducts is established by the setting of potentiometer R706, part of a voltage divider (R702, R706, R708) connected between the -300 and -1000 volt lines. When the Signal Generator frequency control is at a predetermined setting, switch S103 is actuated and places potentiometer R707 in parallel with a portion of potentiometer R706. This results in diode CR703 clipping at a more negative voltage point on the modulation pulse. During any operating mode but amplitude modulation (pulse or square wave), the SYNC SELECTOR switch (S102) opens the cathode of V701, and thus disables the Klystron Modulator.

4-37. KLYSTRON MODULATOR (620B). The Klystron Modulator (Figure 4-12) is comprised of tube V701 and associated parts. The modulation pulse is applied through capacitor C701 to the grid of V701. The output of the Klystron Modulator is developed across plate resistors R703 and R705. Diode CR703 serves as a clipper to limit the amplitude of the pulse applied to the Klystron. When the pulse at the plate of V701 is more positive than the voltage present at the cathode of CR703, the diode conducts and limits the pulse. The voltage at which CR703 conducts is established by the setting of potentiometer R706, part of a voltage divider (R702, R706, R708) connected between the -300 and -1000 volt lines. During any operating mode but amplitude modulation (pulse or square wave),

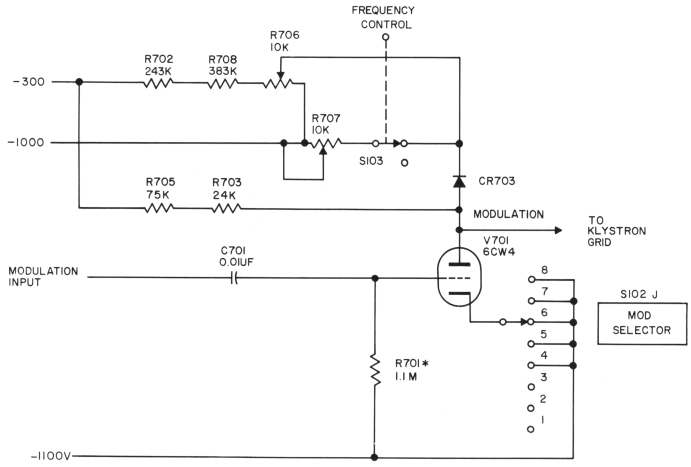


Figure 4-11. Schematic of Klystron Modulator (618C)

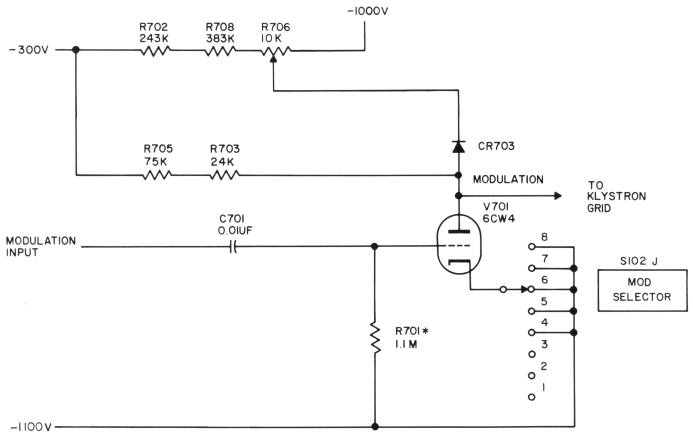


Figure 4-12. Schematic of Klystron Modulator (620B)

the SYNC SELECTOR switch (S102) opens the cathode of V701, and thus disables the Klystron Modulator.

4-38. INTERNAL FM MODULATOR. When MOD. SELECTOR switch S102 is in the FM INT position, the Thyratron Discharge tube comprises a relaxation oscillator (Figure 4-13). This oscillator develops a sawtooth waveform that is applied to the RF Oscillator repeller.

4-39. Capacitors C124, C125, C126, and resistors R146, R147 determine the time constant of the sawtooth

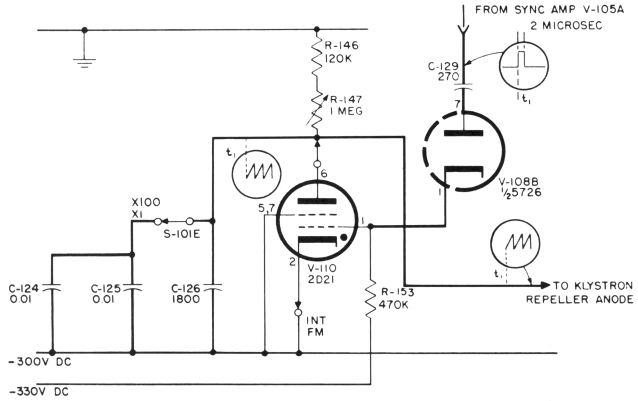


Figure 4-13. Schematic of Frequency-Modulating Circuit

output for the X1 range; while C126, R146 and R147 perform the same function for the X10 range. Resistor R147 is ganged with R111 and R114, and adjusted by the PULSE RATE panel control, so that the FM sweep rate and the internal pulse repetition rate may be controlled by the same control.

4-40. The relaxation oscillator is triggered by a positive pulse from the cathode of the Pulse Shaper and, when activated, delivers a positive-going sawtooth voltage to the repeller, providing frequency modulation.

4-41. THE RF OSCILLATOR.

4-42. REFLEX KLYSTRON. The RF oscillator is a reflex klystron, V114, operating with a tunable coaxial-line resonator. The resonant section is coupled to the resonator grids of the klystron as shown in Figures 4-14 and 4-15 and in the equivalent circuit Figure 4-16.

4-43. Oscillation may be explained by assuming that a small-amplitude, RF noise voltage exists across the resonator grids. The electron stream directed through the resonator grids from the cathode is velocity modulated by this small RF voltage. The stream ceases to be uniform, and may be thought of as having some of its electrons accelerated and some retarded. The resultant stream in the drift space past the resonator grids consists of bunches of electrons, and is therefore said to be velocity modulated.

4-44. As this bunched stream (or velocity modulated stream) moves toward the negative-charged repeller it is repulsed back through the resonator grids. Since the stream is bunched, it induces an RF voltage across the grids.

4-45. If the transit time is in phase with the small thermal RF voltage initially assumed to be across the grids, it strengthens the bunching effect on the following stream. Upon reflection, the electron stream following will again strengthen the resonator grid voltage. This process, however, does not continue indefinitely.

4-46. A point is ultimately reached where the fundamental component of the bunching current decreases in magnitude, since energy is now being used to overcome the circuit resistances. There is a point, therefore, where there is just sufficient reflected energy to satisfy the requirements for stable oscillation.

4-47. Assuming that stable oscillation exists when a sudden change in repeller voltage is introduced, the transit time of the electron stream (as it enters and departs the repeller field) is changed. The current bunching effect would change also, and a new RF voltage would be produced across the resonator grids. This velocity modulation then changes the circuit oscillating frequency.

4-48. The situation previously described is valid for relatively small variations in repeller voltage. Excessive variations alter the relationship between the resonator voltage and the transit time of the electron stream, producing dead spots (no oscillation) or conditions of oscillation in undesired modes.

4-49. The term mode, in this sense, describes two different but interrelated characteristics. One mode is the characteristic of the cavity (or line-section resonator), which is resonant at a series of frequencies when the effective electrical length of the line is 1/4 wavelength, 3/4 wavelength, or 5/4 wavelengths. These effective electrical lengths are termed resonator modes.

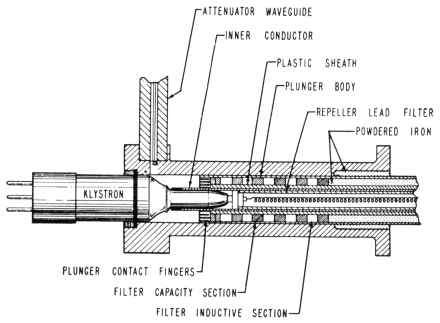


Figure 4-14. Cross-Section of RF Oscillator (620B)

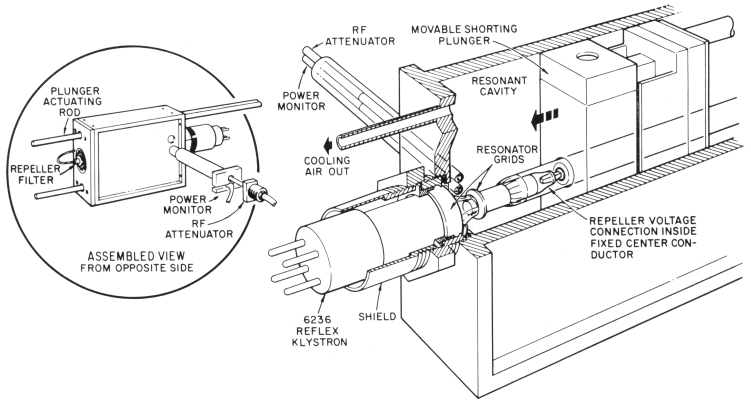


Figure 4-15. Cross-Section of RF Oscillator (618C)

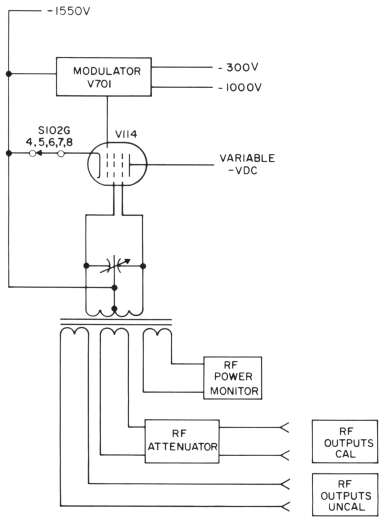


Figure 4-16. Equivalent Circuit of RF Oscillator

4-50. Another mode is the repeller mode, which describes the round-trip transit time of the electron stream as expressed in the cycles of RF voltage across the resonator grids. Oscillations most easily occur when the transit time equals 3/4, 1-3/4, 2-3/4, 3-3/4, 4-3/4 . . . RF cycles. These repeller modes are distinguished by different transit times rather than by different resonant frequencies, and they are functions of repeller voltages. Generally, the value of the repeller voltage increases for a given mode as the mean klystron frequency is increased.

4-51. When a specific repeller mode is desired throughout a given band of frequencies, the repeller voltage is adjusted against the plunger travel (of a tunable resonator, for example) to maintain the relative transit time. Since the repeller mode is a function of transit time, it also remains constant.

4-52. A third use of the term mode is the oscillation mode, which is defined in terms of the repeller mode and the cavity mode. For example, an oscillation mode might be 3/4 wavelength cavity and 3-3/4 wavelength repeller.

4-53. REPELLER VOLTAGE CONTROL (618C). The operating characteristics of a reflex Klystron are such that an optimum value of repeller voltage exists for each operating frequency. This voltage is the value that will cause the bunched electrons to return to the resonator grids at the proper time. Figure 4-17 shows the repeller voltage characteristics for the Klystron over the range employed in the Signal Generator.

4-54. The repeller voltage characteristic shown in Figure 4-17 provides for operation in the 2-3/4 repeller mode. The required voltage for optimum operation

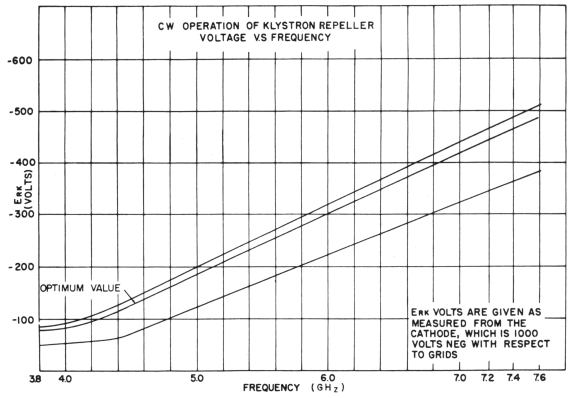


Figure 4-17. Repeller Voltage Versus Frequency (618C)

is essentially linear with frequency for the frequency range above 4400 MHz. In the frequency range from 3800 to 4400 MHz the required voltage is not a linear function of frequency but is slightly curved as shown.

4-55. Figure 4-18 shows the 618C circuit that provides negative voltage to the repeller. Potentiometer R174 is a 100,000-ohm wirewound potentiometer that is mechanically ganged with the mechanism that tunes the resonant line, providing a proper voltage to the repeller electrode as the frequency is changed. The values of the resistor R170 and R175 are adjustable to establish the voltage applied across the tracking potentiometer, R174. The values of resistors R173 and R178 are adjustable to provide the required curvature in the repeller voltage characteristic below 4400 MHz.

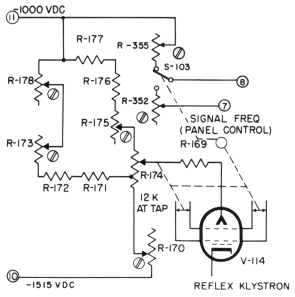


Figure 4-18. Schematic of Repeller Tracking Circuits (618C)

4-56. The ΔF control, R523, is part of a voltage-divider network (R520-R525) that parallels the klystron. Variation of R523 causes small changes in the klystron repeller voltage and thus small changes in the frequency of oscillation.

4-57. PARALLEL-PANEL RESONATOR (618C). The resonator employed in the Model 618C is known as a parallel-plane resonant line. In its physical shape it resembles a rectangular box type cavity with a circular center element and a rectangular plunger to vary the cavity depth. Actually, the line is a direct development from a circular coaxial line as shown in Figure 4-19.

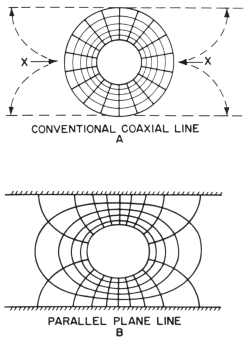


Figure 4-19. Field Configuration of Coaxial and Parallel-Plane Lines (618C)

Part A of Figure 4-19 shows such a line, and the field configurations that exist when it is excited electrically. The resonant frequency of such a line with one end shorted is determined by its electrical length in a direction parallel to the center conductor. The other dimensions of the line play a very small part in determining the oscillating frequency.

4-58. The evolution of the parallel-plane line from the coaxial line may be described by reference to Figure 4-19, parts A and B. Assume the outer conductor were cut at the points X and the two semi-lines thus created were flattened out as shown by the horizontal dotted lines. The voltage and current configurations would then take the form shown in part B. To carry this example through in complete detail, the cross-section of the center conductor would take a slightly elliptical form of perfect configurations. However, for practical purposes, this is not necessary, and a circular center conductor is used.

4-59. The line, as shown in Figure 4-19, part B, is not enclosed on the short sides, and it is possible to operate it in this manner. However, sides are provided to prevent stray RF leakage currents.

4-60. The parallel-plane line depends, for its resonant frequency, upon its electrical length and consequently may be tuned by simple mechanical means and can be directly calibrated. This type of cavity provides a resonator in which simple and straight-forward methods can be employed to provide broadband suppression of the various parasitic resonances that occur when other physical dimensions approach the frequency-determining electrical dimensions.

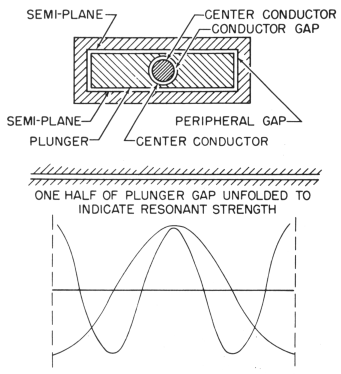


Figure 4-20. Plunger Resonances in Uncompensated Parallel-Plane Line Resonator (618C)

4-61. Figure 4-20 shows a cut-away view of the resonant line and the other components of the parallel-plane oscillator. The klystron is mounted so that one of the resonator grids is coupled to the two semi-lines while the other is coupled to the circular center conductor. The repeller voltage is applied through an insulated filter in the center conductor while the other potentials required to operate the tube are applied through the tube base pins.

4-62. PLUNGER RESONANCE (618C). The plunger employed in the parallel-plane resonator is of the non-contacting type and a small air gap exists between the periphery of the plunger and the surfaces of the semi-planes and sidewalls, as shown in Figure 4-20.

4-63. The gap has a physical length of approximately 17 centimeters, and an electrical length such that it has a two-cycle and a four-cycle resonant frequency occurring near or in the frequency range of the oscillator. As shown in Figure 4-20, these frequencies correspond to one-half and one-quarter of the electrical length of the periphery of the plunger. A similar gap exists between the center conductor and the plunger. However, the length of this gap is such that no resonances occur in the frequency range of the oscillator.

4-64. Compensation is applied to control resonance of the line formed by the peripheral plunger gap in the resonator.

4-65. REPELLER ACTION (620B). As seen in Figure 4-21, the repeller mode for the Model 620B shifts from the 3-3/4 mode to the 4-3/4 mode.

4-66. The 3-3/4 repeller mode is used for the 7- to 9-GHz range, and the 4-3/4 repeller mode is used above 9 GHz.

4-67. The repeller voltage is controlled by a tapered potentiometer ganged to track with the frequency-tuning plunger; it includes a switch which steps the repeller voltage less negative at approximately 8800 GHz to change the transit time to 4-3/4 RF cycles.

4-68. The ΔF control, R523, is part of a voltage-divider network (R520-R525) that parallels the klystron. Variation of R523 causes small changes in the klystron repeller voltage and thus small changes in the frequency of oscillation.

4-69. RESONATOR (620B). The cavity resonator for the klystron is a tunable coaxial line with a shorting plunger. The repeller voltage, plunger, and frequency dial are gang-tuned.

4-70. The resonant frequency for a circular coaxial resonator with one end shorted, is determined by the electrical length of the resonator in a direction parallel to the center conductor. The other dimensions of the line are almost negligible in determining the fundamental frequency of the section.

4-71. UNDESIRED MODE SUPPRESSION (620B). Cavity resonator systems have a tendency to operate in the 1/4-wavelength cavity mode, and from an efficiency and power output standpoint it is

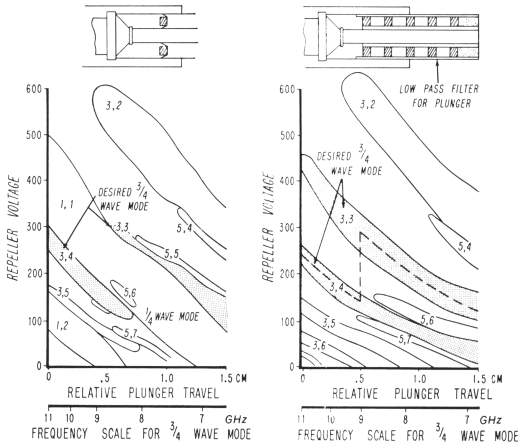


Figure 4-21. Uncompensated and Compensated Mode Structure (620B)

advantageous to operate in the 1/4-wavelength cavity mode. As the desired frequency increases, however, operation in this mode is not always feasible.

4-72. As the desired frequency increases, a 1/4-wavelength becomes quite small and plunger placement in the cavity becomes extremely critical and imposes mechanical limitations, making it necessary to select another mode of operation. The 3/4-wavelength cavity mode is employed for the range of the Model 620B.

4-73. As seen in Figure 4-21 the dominant effects of the 1/4-wavelength mode consist of undesirable mode interference. A study of this 1/4-wavelength cavity and 1-3/4 repeller mode showed that its frequency was below 6000 MHz, considerably below the 7000 MHz low end of the Model 620B. Advantageous use was made of this fact, and the plunger was designed to incorporate a concentric low-pass filter having a cutoff frequency of 6500 MHz.

4-74. PLUNGER CONSTRUCTION (620B). As seen in Figure 4-14, the space between the center conductor of the resonant line and the inner wall of the plunger consists of a number of high- and low-impedance sections in cascade. This constitutes the filter section, which is terminated in back of the plunger with powdered iron to absorb the energy passed by the filter.

4-75. The effectiveness of this approach to the suppression of the undesired mode is seen in Figure 4-21. The filter prevents the undesired mode from supporting itself; the first section of the filter appears as a low impedance for the higher frequencies of the desired modes. In effect, the klystron tube sees a terminated transmission line at frequencies below 6500 MHz. For frequencies above 6500 MHz, the klystron sees a shorted, tunable, high Q resonator.

4-76. The plunger makes contact with the outer conductor wall by means of long-life contact fingers. Peripheral resonances are suppressed by leading the gap between the plunger and the outer wall with a dielectric plastic sheath. The technique effectively lowers the frequency of the parasitics to a range much lower than that of the generator.

4-77. THE ATTENUATOR (618C). Three pickup loops are located in the resonator to collect RF power. The first is the output attenuator loop which couples the calibrated power to be supplied by the generator to the load through an output connector on the panel; the position of this loop is adjustable so that the output power level may be varied as desired. The second is the power level in the oscillating circuit and establishes a reference point to calibrate the output power. The last pickoff loop provides a source of uncalibrated RF power at a front-panel connector.

4-78. Power is coupled to the load from the RF oscillator by a coupling loop located at a suitable point in the resonant line. This loop slides in a circular waveguide section. The cross-section of the waveguide is very small in relation to the frequencies of operation, and normal propagation down the waveguide will not take place. However, some limited propagation does take place, and the power level decreases exponentially as the distance from the resonant line increases. Thus it is possible, by moving a pickup loop linearly in the waveguide, to secure an output that varies in decibels in proportion to the linear travel.

4-79. This type of attenuator is known as an attenuator of the cutoff type and its characteristics are employed so that the pick-up probe and indicating dial can be moved by a simple gear train and the dial may be calibrated directly in decibels.

4-80. A cross-section of the attenuator and RF pick-up loop is shown in Figure 4-22. The RF pick-up loop is terminated by a special resistor, which is made by coating platinum on a glass bead. This resistor is used to match the attenuator to the output cable, and its dc resistance is approximately 50 ohms.

4-81. The polyiron section on the outside of the probe is designed to absorb power that may leak past the probe in the space between the outer conductor and the waveguide walls.

4-82. THE ATTENUATOR (620B). The attenuator in the Model 620B is direct reading and requires no frequency correction. It is essentially a piston probe sliding in a waveguide beyond cutoff.

4-83. Theoretically, the high frequencies beyond cutoff involved in such a waveguide demand dimensions which would be smaller than practical. Consequently the dimensions used have been increased in favor of practical design. Since the dimensions have been increased, there is a slight error introduced because the frequency-versus-attenuation characteristic is not sharp at the cutoff frequency.

4-84. This error is compensated by distributing it over the frequency and the attenuation ranges of the instrument. The compensation is effected by first halving the error by calibrating the attenuator in the middle of the frequency band (approximately 9 GHz). The half-error now exists at the extremes of the band only.

4-85. The net attenuator power-monitor error is less than the maximum error of the instrument, which must allow for the connector mismatches and a source impedance that is not the ideal 50 ohms resistance presented by the pick-up strip on the attenuator probe (Figure 4-23).

4-86. The small dimensions of the waveguide beyond cutoff necessitated careful design of the pickup loops on the power monitor and attenuator probes. The construction details are shown in Figure 4-24.

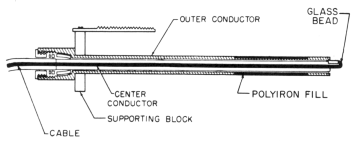


Figure 4-22. Cross-Section View of Attenuator Probe (618C)

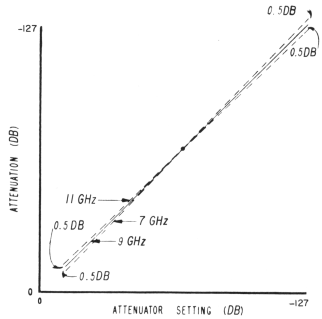


Figure 4-23. Compensation of Attenuator (620B)

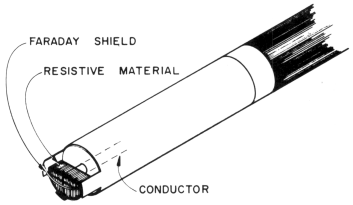


Figure 4-24. Construction Details of Power Monitor Probe (620B)

4-87. THE POWER MONITOR.

4-88. The power monitor circuit is provided to measure and indicate the level of the RF power at the attenuator input.

4-89. The position drive for the attenuator probe is coupled to the calibrated dial, while the drive for the power monitor is coupled to an index which moves around the outside of the calibrated dial. The power monitor probe is nearly a duplicate of the attenuator probe, except that the power picked up by the monitor probe is supplied to a Diode Detector. Figures 4-24 and 4-25 show the 620B power monitor probe. The output of the detector is applied to the Power Monitor Section (Figure 4-26).

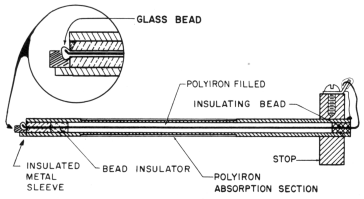


Figure 4-25. Cross-Section View of Power Monitor Probe (620B)

4-90. The Power Monitor Section is composed of a Differential Amplifier acting as a Voltage Comparator. The Differential Amplifier consists of transistors Q601 and Q602 (each a dual-section transistor, with each section in a cascade arrangement), and transistor Q603 acting as a current-feedback generator to increase the input impedance and thus decrease the loading effect on the detected RF signal. The reference input to the differential amplifier is the voltage drop across diode CR602, while the signal to be compared is the detected RF signal. A voltage proportional to the difference in the two input voltages appears between the emitters of Q601A and Q602A, causing the power meter to deflect and indicate the relative power level of the signal Generator output. Potentiometer R612 is the zero-set adjustment for the meter and is adjusted with the MOD. SELECTOR set to OFF (no RF output).

4-91. THE POWER SUPPLIES.

4-92. GENERAL OPERATING PRINCIPLES

4-93. All the dc operating voltages are electronically regulated. Some are obtained directly from regulated supplies, others are derived by voltage division from regulated supplies.

4-94. There are three electronic regulators supplying -300, -1000, and -1550 V. It should be noted that the three power supplies actually develop -300, -700, and -500 V dc; series connection of these voltages results in -300, -1000, and -1550 V. All of the regulators operate as follows. As shown in Figure 4-27, a regulating element (Series Regulator) is connected in series with the load and the dc power source (Rectifier and Voltage Doubler). The resistance of the regulating element is made adjustable so that the voltage at its output will be adjustable. The resistance is adjusted by a control voltage; the higher the control voltage, the higher the output voltage. A sample of the Series Regulator output voltage is compared against a dc reference voltage by a Comparison Amplifier and the difference voltage is inverted and applied to the Series Regulator. As a result, any tendency for the output voltage to change is immediately counteracted by the control voltage, and the supply output voltage remains constant.

4-95. Since the gain of the Comparison Amplifier determines the degree of regulation, it may be followed by an additional Control, or Driver, Amplifier to improve regulation. The Comparison Amplifier is a

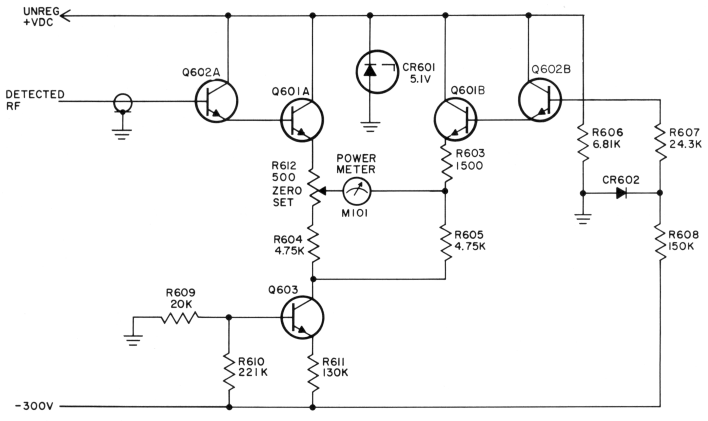


Figure 4-26. Schematic of Power Monitor Circuit

differential type for temperature stability. The dc reference voltage used for comparison is obtained from voltage-regulator electron tubes, from semiconductor voltage-reference diodes, or from another regulated power supply. When an adjustable power supply is used as the reference for another supply, changing its output level also changes the level of the supply for which it is the reference. Consequently, if this reference varies drastically, the output levels of both supplies change.

4-96. -300 VOLT SUPPLY.

4-97. The -300 V supply operates as explained under General Operating Principles. The reference for this supply (applied to the cathodes of V304 through resistor R375) is obtained from the -1000 V supply. In this power supply the Control (Driver) Stage is, like the Comparison Amplifier, a Differential-Type Amplifier.

4-98. -1000 VOLT SUPPLY.

4-99. The -1000 V supply operates as explained under General Operating Principles, and derives its reference from V402. The Comparison Amplifier, V403 and 404, drives the Series Regulator directly. The Regulator receives its screen voltage from regulator tube V305, which, in turn, uses the -300 V supply as a B+ source; consequently, any drastic variation of the -300 V supply will affect the -1000 V supply.

4-100. -1550 VOLT SUPPLY.

4-101. The -1550 V supply operates as explained under General Operating Principles, and derives its reference from V502. The Comparison Amplifier, V503 and V504, drive the Series Regulator directly. The Series Regulator receives its screen voltage from a voltage divider (R514, R515) across the -300 and -1000 V supplies; hence, any drastic variation in either of these two supplies will affect the -1550 V supply.

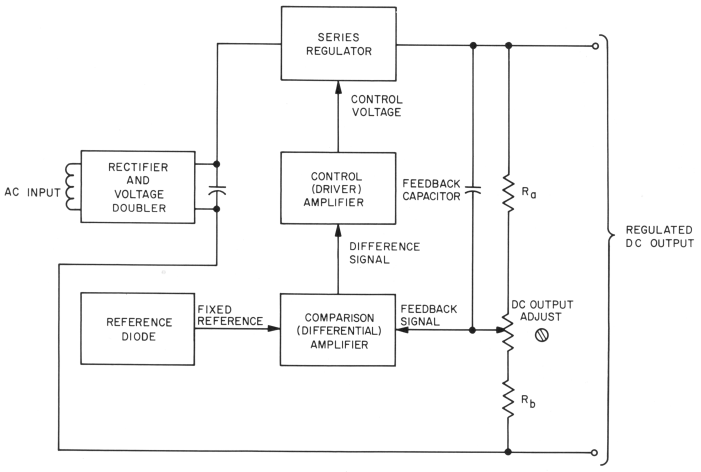


Figure 4-27. Power Supply Block Diagram

Table 5-1. Test Equipment Required for Performance Testing

Instrument	Critical Specification	Recommended Models
Thermistor Mount	Frequency range: 3.8 to 11 GHz SWR: 2.0 max	HP 8478A
Power Meter	Power range: 0 to -30 dBm Accuracy: ±3%	HP 431B/431C
Adjustable Transformer	Output voltage range: 103.5-126.5 and 207-253 volts ac	General Radio W10MT3A
Electronic Counter	Frequency range; 50 to 500 MHz Accuracy: ±1 count ±3 parts in 10^9	HP 5245L with 5253B plug-in
Microwave Frequency Converter	Frequency range: 3.8 to 11 GHz Must contain built-in discriminator to measure FM deviation	HP 2590A
Oscilloscope	Vertical sensitivity: 0.05V/cm Bandwidth: 50 MHz	HP 175A with 1750B plug-in
Crystal Detector	Frequency range: 3.8 to 11 GHz Frequency response: ±0.5 dB per octave SWR: 1.5	HP 423A
Oscillator	Frequency range: 40 Hz to 4 kHz Voltage output: 0 to 10 volts rms Frequency Accuracy: ±2%	HP 200C/D
Vacuum Tube Voltmeter	Range: 0 to 10 volts ac Accuracy: ±3% of full scale	HP 410B/410C
Pulse Generator	Frequency range: 1000 Hz Voltage output ±20 and ±70 volts peak Pulse width: 0.5 and 2500 micro-seconds	HP 214A
Spectrum Analyzer	Frequency Range: 3.8 to 11 GHz IF Bandwidth: 10 kHz	HP 8551/851A/B

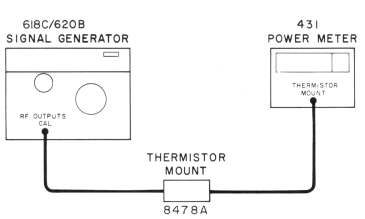


Figure 5-1. Setup for Testing RF Output Accuracy

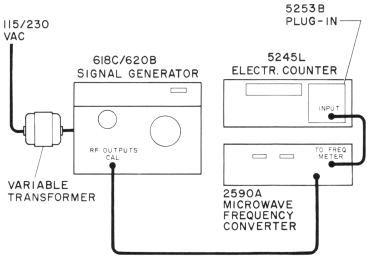


Figure 5-2. Setup for Testing Frequency Accuracy

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section provides instructions for performance testing, calibrating, troubleshooting, and repairing the Signal Generator.

5-3. MAINTENANCE PRECAUTIONS.

WARNING

VOLTAGES IN EXCESS OF 1550 VOLTS INSIDE CABINET. USE EXTREME CARE WHEN SIGNAL GENERATOR IS REMOVED FROM CABINET.

5-4. PERIODIC INSPECTION.

5-5. CLEANING.

5-6. If the equipment has been subjected to unusual conditions (excessive moisture, dust, heat, vibration, etc.) it is suggested that the instrument be removed from the cabinet and inspected for dirt or moisture accumulation, loosened components, or any possible sign of damage. Forced air under medium pressure is recommended for dusting and drying, although care must be taken not to vary the settings of the internal-adjustment potentiometers and components during the process. Inspect the air filter regularly and, if necessary, remove and wash in detergent and water. Dry filter and replace: no oiling or coating of the filter is necessary. Unrestricted air flow gives longest component life. Keep the filter clean.

5-7. LUBRICATION.

5-8. No routine lubrication is needed. Lubricate mechanical parts (frequency drive gears, drive mechanism) only when necessary, using a light machine oil. Lubricate moving parts, such as the attenuator and power-monitor probe rack gears, with dry molybdenum or graphite lubricant. The cavity plunger is permanently lubricated during manufacture and requires no subsequent lubrication.

5-9. PERFORMANCE TESTS.

5-10. PURPOSE.

5-11. The following paragraphs check performance for incoming inspection, periodic evaluation, troubleshooting, and calibration. The tests can be performed without access to the Signal Generator interior. The specifications of Table 1-1 are the performance standards.

5-12. TEST EQUIPMENT REQUIRED.

5-13. The test instruments required to make the performance tests are listed in Table 5-1. Test instruments other than those listed may be used provided performance equals or exceeds Critical Specifications.

5-14. RF POWER-OUTPUT ACCURACY CHECK:

a. Connect Signal Generator in test setup shown in Figure 5-1.

b. Set Signal Generator controls as follows:

LINE	ON
MOD. SELECTOR	CW
POWER SET	0
OUTPUT ATTN	0 dB

c. Adjust 618C Signal Generator frequency control from 3.8 to 7.6 GHz; Power Meter should indicate 0 ±3 dBm.

c. Adjust 620B Signal Generator frequency control from 7 to 11 GHz; Power Meter should indicate 0±3 dBm.

d. Adjust OUTPUT ATTEN control from 0 to -30 dBm in 1-dB steps; Power Meter indication should agree with OUTPUT ATTEN setting ±3 dBm from 0 to -7 dBm and ±2 dBm from -7 to -30 dBm.

5-15. FREQUENCY ACCURACY, STABILITY, AND ΔFM CHECK.

a. Connect Signal Generator in test setup shown in Figure 5-2.

b. Adjust variable transformer for 115 (or 230) V.

c. Set Signal Generator controls as follows:

LINE	ON
MOD. SELECTOR	CW
Frequency (618C)	3.8 GHz
Frequency (620B)	7 GHz
POWER SET	0
ΔF	Centered

d. Adjust Signal Generator OUTPUT ATTEN control for sufficient output to drive Microwave Frequency Converter.

e. Adjust Microwave Frequency Converter and Electronic Counter to measure frequency.

f. (618C.) Electronic Counter shall indicate 3.762 to 3.838 GHz; record indication.

f. (620B.) Electronic Counter shall indicate 6.930 to 7.070 GHz; record indication.

g. (618C.) Adjust variable transformer for 103.5 (or 207) V; Electronic Counter indication should be within 0.76 MHz of indication recorded in step e.

g. (620B.) Adjust variable transformer for 103.5 (or 207) V; Electronic Counter indication should be within 1.4 MHz of indication recorded in step e.

h. (618C.) Adjust variable transformer for 126.5 (or 253) V; Electronic Counter indication should be within 0.76 MHz of indication recorded in step e.

h. (620B.) Adjust variable transformer for 126.5 (or 253) V; Electronic Counter indication should be within 1.4 MHz of indication recorded in step e.

i. (618C.) Repeat steps c through h for Signal Generator frequencies of 5.7 and 7.6 GHz. Refer to the following table for proper indications:

i. (620B.) Repeat steps c through h for Signal Generator frequencies of 9 and 11 GHz. Refer to the following table for proper indications:

618C Signal Generator Frequency	Line Voltage		
	115/230	103.5/207	126.5/253
5.7 GHz	5.653-5.7057 GHz	±1.04 MHz	±1.04 MHz
7.6 GHz	7.524-7.676 GHz	±1.52 MHz	±1.52 MHz

620B Signal Generator Frequency	Line Voltage		
	115/230	103.5/207	126.5/253
9 GHz	8.910-9.090 GHz	±1.8 MHz	±1.8 MHz
11 GHz	10.890-11.110GHz	±2.2 MHz	±2.2 MHz

j. Adjust transformer for 115 (or 230) V.

k. Adjust ΔF control to extreme ccw position.

m. (618C.) Adjust Signal Generator frequency control to 3.8 GHz.

m. (620B.) Adjust Signal Generator frequency control to 7 GHz.

n. Measure Signal Generator frequency on Electronic Counter; record reading.

p. Adjust ΔF control fully cw, and measure Signal Generator output frequency; frequencies measured in this step and step n must differ by approximately 0.5 MHz for 618C; 1.5 MHz for 620B.

5-16. UNCALIBRATED RF OUTPUT CHECK.

a. Connect Signal Generator in test setup shown in Figure 5-1 but connect Thermistor Mount input to RF OUTPUTS UNCAL connector.

b. Set Signal Generator controls as follows:

LINE . . . . . ON
MOD. SELECTOR . . . . . CW

c. (618C.) Adjust Signal Generator frequency control from 3.8 to 7.6 GHz; Power meter should indicate 0.3 mW minimum over frequency range.

d. (620B.) Adjust Signal Generator frequency control from 7 to 11 GHz; Power meter should indicate 0.3 mW minimum over frequency range.

5-17. INTERNAL PULSE-MODULATION CHECK.

a. Connect Signal Generator in test setup shown in Figure 5-3.

b. Set Signal Generator controls as follows:

LINE . . . . . ON
MOD. SELECTOR . . . . . INT
SYNC SELECTOR X1
PULSE RATE 40

c. Electronic Counter should indicate 40 ±10 Hz.

d. Adjust PULSE RATE control to 400; counter should indicate 400 ±100 Hz.

e. Set SYNC SELECTOR to X10; counter should indicate 4000 ±1000 Hz.

f. Adjust PULSE RATE control to 40; counter should indicate 400 ±100 Hz.

g. Adjust PULSE WIDTH control from extreme ccw to cw position and observe Oscilloscope; width of pulses should vary from 0.5 to 10 μs (50% points). Pulse width error should not exceed ±1 μs from 1 through 5 and ±20% from 6 through 10.

h. Set oscilloscope time base for 1 μsec/cm. Adjust the PULSE DELAY control to its extreme CCW position and observe the oscilloscope. Pulse delay should be less than 3 μsec from left side of CRT. Set oscilloscope for 50 μsec/cm and adjust PULSE DELAY control fully CW. Pulse delay should be greater than 300 μsecs.

5-18. INTERNAL SQUARE-WAVE MODULATION CHECK.

a. Connect Signal Generator in test setup shown in Figure 5-3.

b. Set Signal Generator controls as follows:

LINE . . . . . ON
MOD. SELECTOR . . . . . ⊓⊔
SYNC SELECTOR X1
PULSE RATE 40

c. Electronic Counter should indicate 40 ±10 Hz and Oscilloscope should indicate symmetrical square wave.

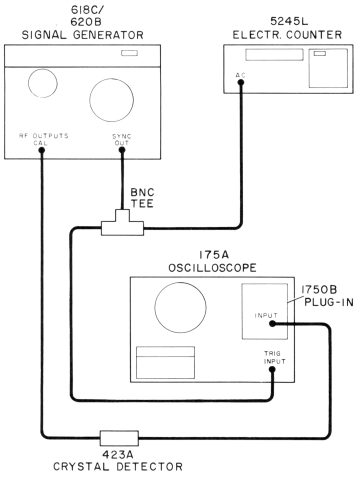


Figure 5-3. Setup for Testing Internal Pulse Modulation

d. Adjust PULSE RATE control to 400; counter should indicate 400 ±100 Hz.

e. Set SYNC SELECTOR to X10; counter should indicate 4000 ±1000 Hz.

f. Adjust PULSE RATE control to 40; counter should indicate 400 ±100 Hz.

5-19. EXTERNAL PULSE CHECK.

a. Connect Signal Generator in test setup shown in Figure 5-4.

b. Set Signal Generator controls as follows:

LINE	ON
MOD. SELECTOR	+EXT
POWER SET	0
OUTPUT ATTEN	0 dB

c. Adjust Pulse Generator for a +20 V peak, 1000-Hz output with a pulse width of 0.5 μs.

d. Observe Oscilloscope for 1000-Hz, 0.5-μs pulses at 100% modulation.

e. Adjust Pulse Generator for a +70 V peak output; Oscilloscope should indicate 100% modulation.

f. Adjust Pulse Generator for an output pulse width of 2500 μs.

g. Observe Oscilloscope for 1000-Hz, 2500-μs pulses at 100% modulation.

h. Adjust Pulse Generator output to +20 V peak; Oscilloscope should indicate 100% modulation.

i. Set MOD. SELECTOR to -EXT.

j. Repeat steps c through h with pulse generator adjusted to negative pulse output.

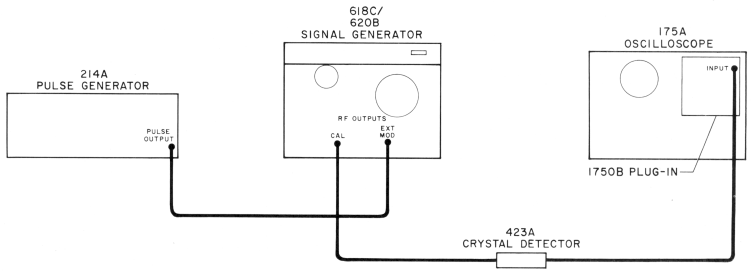


Figure 5-4. Setup for Testing External Pulse Modulation

5-20. INTERNAL FM CHECK.

a. Connect Signal Generator in test setup shown in Figure 5-5 without the oscillator in the setup.

b. Set Signal Generator controls as follows:

LINE	ON
MOD. SELECTOR	INT. FM
Frequency (618C)	5 GHz
Frequency (620B)	7 GHz
POWER SET	0
OUTPUT ATTEN	0 dBm
SYNC SELECTOR	X10
PULSE RATE (1000 pps)	100
FM AMPLITUDE	max ccw

c. Advance FM amplitude control in clockwise direction until the display indicates maximum FM deviation without unstable operation. FM deviation should be 5 MHz p-p minimum.

d. Repeat step c at desired frequencies. FM deviation should be 5 MHz minimum over most of band.

e. Set SYNC SELECTOR to X10.

f. Set PULSE RATE control 50.

g. Repeat steps c and d.

5-21. EXTERNAL FM CHECK.

a. Connect Signal Generator in test setup shown in Figure 5-5.

b. Set Signal Generator controls as follows:

LINE	ON
MOD. SELECTOR	EXT. FM
Frequency (618C)	5 GHz
Frequency (620B)	7.0 GHz
POWER SET	0
OUTPUT ATTEN	0 dBm
FM AMPLITUDE	max ccw

c. Adjust Oscillator output for maximum at 1000 Hz.

d. Advance FM AMPLITUDE control in clockwise direction until display indicates maximum FM deviation without unstable operation. FM deviation should be 5 MHz minimum.

e. Repeat step d at desired frequencies. FM deviation should be 5 MHz p-p minimum over most of the band.

f. Decrease oscillator output and observe FM deviation: FM deviation should decrease proportionally.

5-22. EXTERNAL SINE-WAVE SYNCHRONIZATION CHECK.

a. Connect Signal Generator in test setup shown in Figure 5-6.

b. Set Signal Generator controls as follows:

LINE	ON
MOD. SELECTOR	INT
POWER SET	0
OUTPUT ATTEN	0 dB
SYNC SELECTOR	∿

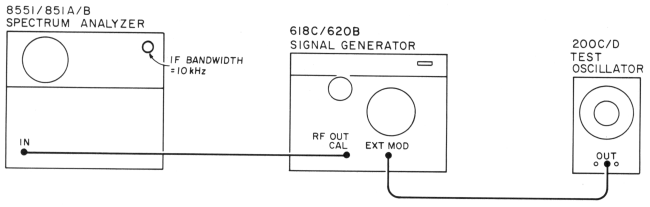


Figure 5-5. Setup for Testing Internal and External FM

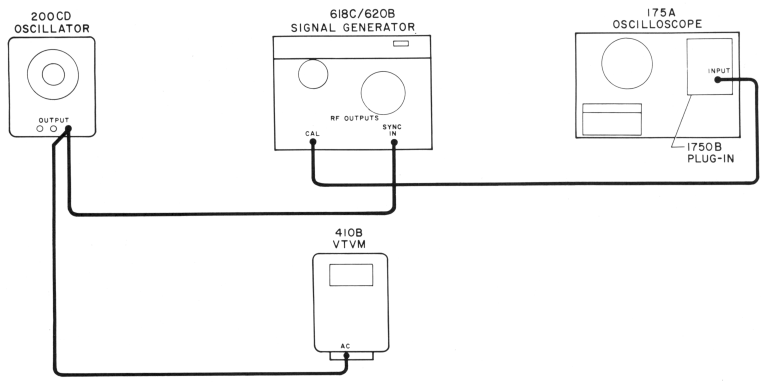


Figure 5-6. Setup for Testing External Sine-Wave Synchronization

c. Adjust Oscillator for 40-Hz, 5 V rms input to Signal Generator.

d. Observe Oscilloscope for 40-Hz pulses.

e. Adjust Oscillator for 4000-Hz output; observe Oscilloscope for 4000-Hz pulses.

5-23. EXTERNAL PULSE SYNCHRONIZATION CHECK.

a. Connect Signal Generator in test setup shown in Figure 5-6, but replace Oscillator with Model 214A Pulse Generator.

b. Set Signal Generator controls as follows:

LINE	ON
MOD. SELECTOR	INT
POWER SET	0
OUTPUT ATTEN	0 dB
SYNC SELECTOR	EXT +

c. Adjust Pulse Generator for 10-Hz, +5 V peak output with a pulse width of 0.5 μs.

d. Observe Oscilloscope for 10-Hz pulses.

e. Adjust Pulse Generator for +50 V peak output; repeat step d.

f. Adjust Pulse Generator for 5-μs pulse width; repeat step d.

g. Adjust Pulse Generator for 4000-Hz output.

h. Observe Oscilloscope for 4000-Hz pulses.

i. Adjust Pulse Generator for 5 V output; repeat step h.

j. Adjust Pulse Generator for 0.5-μs pulse width; repeat step h.

k. Set SYNC SELECTOR to EXT-.

m. Repeat steps c through j using negative pulses.

5-24. ADJUSTMENTS.

5-25. TEST EQUIPMENT REQUIRED.

5-26. Test instruments required to perform the adjustments are listed in Table 5-2. Instruments other than those listed may be used provided their specifications equal or exceed the Critical Specifications.

5-27. POWER-SUPPLY VOLTAGE ADJUSTMENTS.

5-28. There are two adjustable voltages: -700 (-1000V supply) and -500 (-1550 V supply) V. Adjust these voltages only if proven by accurate measurement to be outside the tolerances specified below. Adjust the output voltage of the -700 V regulator first and then adjust the -500 V regulator. After adjusting any regulator, check the output voltage of the other regulators to ensure they are within specified tolerances.

a. Connect an adjustable transformer to control Signal Generator line voltage.

b. Set Signal Generator controls as follows:

LINE	ON
MOD. SELECTOR	CW
POWER SET	0
Frequency (618C)	7.6 GHz
Frequency (620B)	11 GHz

Table 5-2. Test Equipment Required for Calibration and Troubleshooting

Test Instrument	Critical Specifications	Recommended Model
All instruments listed in Table 5-1		
Electronic Voltmeter	Range: 0 to 1550 volts Accuracy: ±2%	HP 410C
Clip-On DC Milliammeter	Range: 0.1 mA to 10 amperes Accuracy: ±3% of full scale ±0.1 mA	HP 428B
Frequency Meter	Frequency range: 3.8 to 7.6 GHz (618C) Accuracy: ±0.1%	HP 536A, G532A, and J532A
	Frequency range: 7 to 11 GHz (620B) Accuracy: ±0.1%	HP 532A and X532B
Function Generator	Frequency range: 0.008 to 1200 Hz Output voltage: .30 volts peak	HP 202A

c. Adjust Transformer for 115 (or 230) V.

d. Connect Electronic Voltmeter to test jack J6 (+) and ground (-).

e. Adjust potentiometer R412 (Figure 5-7) for -1000 ±20 volts. Line voltage regulation (115 V ±10%) should hold the -1000 V supply to within ±5V; ripple should be less than 10 mV, p-p. The -300 V supply should track the -1000 V supply to -300 +10 V. Line voltage regulation (115 V ±10%) should hold the -300 V supply to within ±5 V; ripple should be less than 10 mV, p-p.

f. Connect Electronic Voltmeter to test jack J5 (+) and ground.(-).

g. Adjust potentiometer R512 (Figure 5-7) for -1550 ±20 V. Line voltage regulation (115 V ±10%) should hold the -1550 V supply to within ±5 V; ripple should be less than 15 mV, p-p.

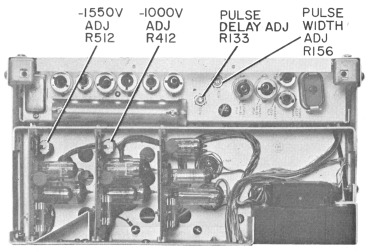


Figure 5-7. Location of Power Supply and Modulator Adjustments

5-29. ADJUSTMENTS FOLLOWING REPLACEMENT OF KLYSTRON V114 (618C).

5-30. Following replacement of V114, it is important that certain adjustments be made as soon as the Signal Generator is turned on. The following procedure is recommended.

a. With the signal generator removed from the cabinet and with MOD. SELECTOR on OFF, turn on signal generator.

b. Check the -300, -700, and -500 volt supplies (see paragraph 5-27).

c. With the MOD. SELECTOR set to CW, adjust R707 (Figure 5-8) for a klystron cathode current of 25 mA maximum (approximately 15 mA).

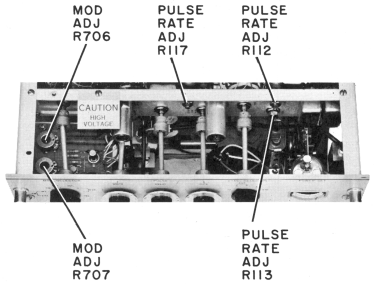


Figure 5-8. Location of Klystron and Modulator Adjustments (618C)

Note

A new klystron tube should now operate at least partially over the frequency range with original repeller voltage settings and for the most part, will require only 1/8 turn to bring the repeller voltage to optimum.

d. Connect instrument as shown in Figure 5-9.

e. Set MOD. SELECTOR to INT. (SYNC SELECTOR to X10). Tune frequency control to 7.6 GHz.

f. Adjust R170 for optimum pulse shape.

g. At this point it is advisable to check the dial calibration at the high end stop. This check avoids possible retracking adjustments when the dial calibration is adjusted later. To conduct the check, tune frequency control to high end stop and place wavemeter in circuit as shown in Figure 5-9. Wavemeter should indicate 7.650 GHz. When the wavemeter is tuned to the actual frequency of the generator a slight decrease in the peak level of the pulse appears on the scale. If this frequency is more than 25 MHz away from 7.650 GHz perform step d in paragraph 5-34.

h. Remove wavemeter and reconnect output cable as shown in Figure 5-9. Tune the frequency control toward 5 GHz, adjusting R170 (Figure 5-11) for best pulse shape between 7.6 and 5 GHz.

i. Tune the frequency control between 5 and 4.2 GHz; adjust R173 and/or R178 (Figure 5-11) for optimum pulse shape.

j. Continue tracking the dial downward toward 3.8 GHz, adjusting R175 for optimum pulse.

k. Tune the frequency control back toward 7.6 GHz observing the pulse shape on the oscilloscope. Readjust the appropriate reflector tracking potentiometer for optimum pulse shape.

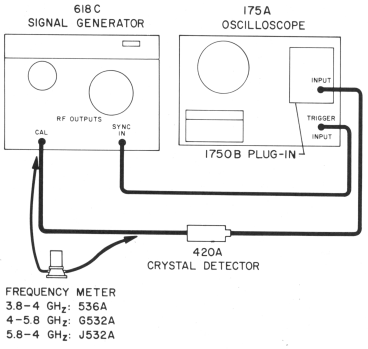


Figure 5-9. Setup for Frequency Dial Calibration (618C)

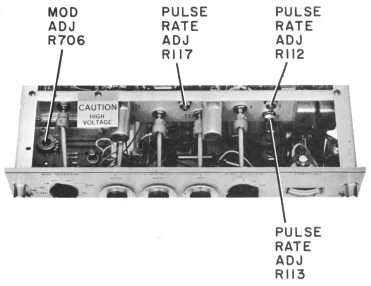


Figure 5-10. Location of Klystron and Modulator Adjustments (620B)

m. If pulse misfiring or jitter occurs at any point in the band which cannot be corrected by adjustment of the reflector tracking potentiometers, adjust R706 for frequencies above the microswitch operation and R707 for frequencies below the microswitch operation.

n. Set the MOD. SELECTOR to SQ. WAVE and observe the waveshape across the band. The waveshape may be improved by repeating the adjustment of R706 and R707 as outlined in step m preceding.

p. Check frequency dial calibration as described in paragraph 5-33.

5-31. ADJUSTMENTS FOLLOWING REPLACEMENT OF KLYSTRON V114 (620B).

5-32. Following replacement of V114, it is important that certain adjustments be made as soon as the signal generator is turned on. The following procedure is recommended.

a. With Signal Generator removed from cabinet set MOD. SELECTOR to OFF and turn on instrument.

b. Check -300, -700 and -500 V supplies, and klystron cutoff bias. Refer to paragraph 5-27 for power supply adjustments.

c. Adjust frequency control to 10 GHz.

d. Set MOD. SELECTOR to CW and measure klystron beam current with 428A Clip-on DC Milliammeter. Adjust potentiometer R706 (Figure 5-10) for 22-mA klystron beam current.

e. Adjust POWER SET control to obtain up-scale indication on the power set meter. If necessary, adjust potentiometer R170 (Figure 5-11) to obtain proper meter indication. Recheck klystron beam current (25 mA maximum).

f. Adjust Signal Generator to a frequency just above the point where the microswitch is actuated (approximately 8.8 GHz).

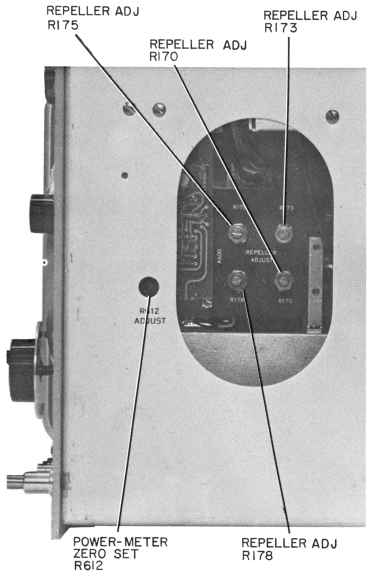


Figure 5-11. Location of Tracking and Power-Set Meter Adjustments

g. Connect Signal Generator in test setup shown in Figure 5-12.

h. Set MOD. SELECTOR to EXT FM and observe repeller mode pattern on Oscilloscope. Adjust OUTPUT ATTEN and external modulating voltage to obtain the desired vertical deflection on Oscilloscope. Adjust FM AMPLITUDE control to obtain humped waveform shown in Figure 5-12. If necessary adjust the phase of repeller mode pattern.

i. Adjust Signal Generator across entire band while observing the repeller mode pattern on Oscilloscope. If the RF power level drops abruptly (in general, between 8.4 and 8.7 GHz), proceed as follows:

(1) Turn off Instrument.

(2) Loosen klystron mounting nut.

(3) Rotate klystron slightly and make sure klystron is seated properly against shoulder in collet.

(4) Tighten klystron mounting nut by hand.

(5) Check to be sure that the repeller cable is not twisted and makes firm connection to repeller.

(6) Turn on Instrument and observe repeller mode patterns on oscilloscope.

Repeat steps (1) through (6) preceding, rotating klystron slightly each time until the optimum repeller mode pattern is obtained across entire band.

j. Turn off Instrument. Set frequency dial at high-frequency stop and tighten klystron mounting nut.

k. Install tube socket housing with cable entrance towards rear of instrument. Replace four screws.

m. Turn on Signal Generator.

n. Measure Signal Generator output frequency with Frequency Meter. If the measured frequency is below 11.1 GHz, remove bottom plate from frequency drive mechanism and perform (1) through (4) following; if not, perform (5) through (9) following:

(1) Loosen plunger cap screw (Figure 5-13).

(2) Adjust Frequency Meter to 11.1 GHz.

(3) Gently tap rear of plunger until Frequency Meter dip is centered on mode pattern.

(4) Tighten plunger cap screw and replace bottom plate.

(5) Set Frequency Meter to 11.1 GHz.

(6) Adjust frequency dial until Frequency Meter pattern is centered on the mode pattern.

(7) Loosen plunger cap screw.

(8) Turn frequency dial to high frequency stop while holding plunger stationary.

(9) Tighten plunger cap screw and replace bottom plate.

p. Tune Signal Generator across entire band and center repeller mode pattern with repeller tracking potentiometer R170, R173, R175, and R178 (Figure 5-9). Figure 5-12 (A and C) shows two typical mode patterns. Figure 5-12A shows a symmetrical mode pattern that is properly centered by the correct repeller voltage; Figure 5-12B shows the same pattern set off-center by incorrect setting of repeller voltage. Adjust potentiometer R170 and R178 (Figure 5-11) to obtain correct repeller voltage tracking between 11 GHz and the frequency just above the point where the microswitch is actuated (approximately 8.7 to 9 GHz). Adjust potentiometers R173 and R175 (Figure 5-11) to obtain correct repeller voltage tracking between the frequency just below the point where the microswitch is actuated (approximately 8.6 GHz) and 7 GHz.

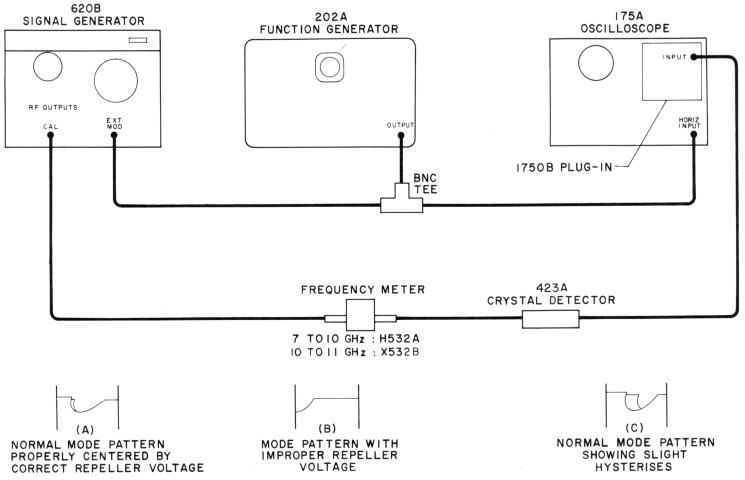


Figure 5-12. Test Setup for Klystron Adjustment (620B)

q. Check Signal Generator output using square-wave and pulse operations over the entire frequency band. If the shape of waveform deteriorates, readjust the appropriate repeller tracking control at the frequency where instability appears.

r. Recheck the entire frequency band and make any minor refinements which may be necessary for best overall operation; that is, stable CW, square-wave, and pulse operation with specified power output over the full frequency range.

5-33. CALIBRATING THE FREQUENCY DIAL (618C)

5-34. Replacing the klystron will usually reduce the accuracy of the frequency dial by several percent from its rated accuracy of 1%. If accuracy of frequency dial calibration is important, the following procedure can be used to restore accuracy. This procedure requires a wavemeter covering the frequency range or a frequency standard setup. In general when a new klystron oscillator tube is installed it will be necessary to slip the frequency dial slightly to bring into calibration. In some cases, it may also be necessary to reset the plunger depth at the high frequency end of the band to reestablish the correct high frequency limit. There are no trimmers or other adjustment; all adjustments for frequency recalibration must be done mechanically. To recalibrate the frequency dial following a change in klystron oscillator tube, proceed as follows:

a. Set MOD. SELECTOR switch to CW. The equipment should be allowed a warm-up of at least 20 minutes before checking calibration.

b. Tune signal generator to 7.650 GHz.

c. Measure output frequency with wavemeter. If reading of MHz dial is in error by more than approximately 100 MHz, it will be necessary to remove plate that covers frequency drive assembly.

d. With MHz dial still set at 7.650 GHz, loosen set screws holding resonator plunger rods in approximately 1/32 inch steps until output frequency is approximately 7.650 GHz as indicated by wavemeter. Tighten set screws in drive bar in this position.

e. Tune Signal Generator to 7.5 GHz. Measure output frequency with wavemeter. If output frequency does not agree with dial within 1%, adjust the frequency dial slightly by slipping it on its shaft.

f. Check calibration of MHz dial through range of generator, using a microwave standard and suitable detector. If accuracy at lower frequencies is outside 1% tolerance, the dial can be slipped slightly on its shaft to obtain desired accuracy at lower frequencies.

g. It may not be possible to achieve 1% overall accuracy with some replacement klystrons. In this case try another klystron and repeat procedure.

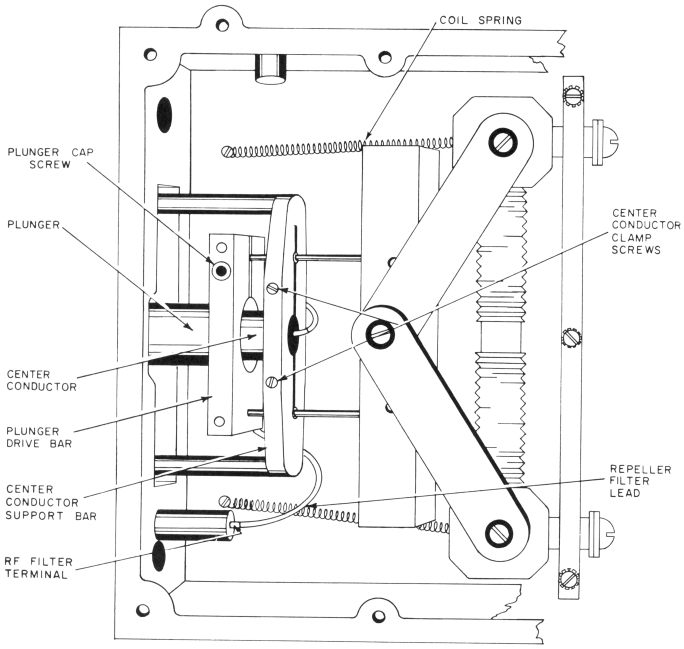


Figure 5-13. Frequency Drive Mechanism, Cover Plate Removed (620B)

5-35. CALIBRATING THE FREQUENCY DIAL (620B).

5-36. Replacing the klystron will usually reduce the accuracy of the frequency dial by several percent from its rated accuracy of 1%. If accuracy of frequency dial calibration is important, the following procedure can be used to restore accuracy. In general, when a new klystron oscillator tube is installed it is necessary to slip the frequency dial slightly to bring it into calibration. In some cases, it may also be necessary to re-set the plunger depth to re-establish the correct high-frequency limit. All adjustments for frequency recalibration must be done mechanically. To recalibrate the frequency dial following a klystron change proceed as follows:

a. Following initial voltage adjustments (paragraph 5-32), set MOD. SELECTOR to CW and allow Signal Generator to warm up for 20 minutes.

b. Assuming that the repeller adjustments have been set for best operation of the new klystron, tune Signal Generator to the highest frequency at which the klystron will oscillate; measure this frequency with a Frequency Meter.

c. If the klystron cannot be made to oscillate up to 11 GHz, refer to the troubleshooting procedures.

d. If the klystron oscillates satisfactorily up to 11.1 GHz, check the frequency-dial calibration accuracy over the full frequency range. If the dial calibration is too high or too low over the entire range by a nearly equal amount, the frequency dial may be slipped into calibration by removing the frequency dial cover, loosening the dial hub, and turning the dial a small amount.

e. If slipping the dial will not bring both the high and low ends of the frequency dial into calibration, the high end can first be correctly set by altering the depth of the cavity plunger slightly to obtain the correct upper frequency limit and then slip the dial to bring the low frequency end into calibration.

f. To set the high-frequency limit of the klystron by shifting the plunger setting, remove the bottom plate from the frequency-drive casting to expose the plunger mechanism.

g. Adjust the signal generator to produce 11 GHz as read on the Frequency Meter.

h. Refer to Figure 5-13 and loosen the cap screw holding the plunger in the plunger-drive bar.

i. Holding the plunger in the 11 GHz position, adjust the frequency drive for a reading of 11 GHz on the dial. Tighten cap screw.

j. If oscillation stops when the plunger is moved, readjust the appropriate repeller voltage potentiometer to regain oscillation.

k. Recheck low end of frequency range noting frequency dial accuracy. If dial is inaccurate, remove dial cover, loosen hub slightly and slip frequency dial to correct indication.

m. Recheck accuracy of frequency dial at main points across the band. Refine the foregoing adjustments to produce the best overall accuracy.

n. If the frequency spread of a new klystron tube is much greater or less than that of the original tube, it may not be possible to use the original dial for the new tube. In this case, another klystron must be tried or a new frequency dial must be calibrated.

5-37. CALIBRATING THE PULSE RATE CONTROL.

5-38. Replacing Tube V103 or associated components may lessen the accuracy of the PULSE RATE control but will not otherwise affect the performance of the Signal Generator. It should be noted, however, that the calibration of this dial is only approximate. To calibrate the PULSE RATE dial, proceed as follows:

a. Set Signal Generator controls as follows:

MOD. SELECTOR	INT.
PULSE WIDTH	max cw
PULSE DELAY	max ccw
PULSE RATE	max ccw
SYNC SELECTOR	X10

b. Connect Electronic Counter to SYNC OUT connector.

c. Adjust potentiometer R112 (Figure 5-8) so that the counter indicates 4800 Hz.

d. Set SYNC SELECTOR to X1.

e. Adjust potentiometer R113 (Figure 5-8) so that counter indicates 480 Hz.

f. Set PULSE RATE fully ccw.

g. Adjust potentiometer R117 (Figure 5-8) so that counter indicates 30 Hz.

h. Adjust PULSE RATE control for a counter reading of 200 Hz.

i. Loosen PULSE RATE dial and adjust to a reading of 200.

5-39. CALIBRATING THE PULSE DELAY CONTROL.

5-40. Replacing tube V107 may degrade the accuracy of the PULSE DELAY Control. After replacing V107, the following procedure can be used to adjust the delay calibration. It should be noted, however, that the calibration of the PULSE DELAY dial is intended only to be approximate.

a. Connect the DELAY SYNC OUT terminal to an oscilloscope vertical input.

b. Synchronize the Oscilloscope with signal at SYNC OUT connector.

c. Set PULSE DELAY control to 300 μs.

d. Adjust potentiometer R133 (Figure 5-7) to give a delay of 300 μs as measured on the calibrated Oscilloscope.

e. Set PULSE DELAY control to 50 μs as indicated by Oscilloscope. (The delay is indicated by the interval between the start of the Oscilloscope trace and the leading edge of the delayed sync pulse.) If necessary, slip the PULSE DELAY dial on its shaft to make calibration accurate.

5-41. CALIBRATING THE PULSE WIDTH CONTROL.

5-42. Replacing Tube V111 may lessen the accuracy of the PULSE WIDTH Control. This control is intended to be accurate within 20% or 1 μs, whichever is greater. To calibrate the PULSE WIDTH control, proceed as follows:

a. Connect RF OUTPUTS UNCAL through a Crystal Detector to vertical input of an Oscilloscope.

b. Synchronize Oscilloscope with signal at the SYNC OUT connector.

c. Set PULSE WIDTH control to 10 μs.

d. Adjust potentiometer R156 (Figure 5-7) so that width of pulse of 10 μs as measured on the Oscilloscope.

e. Set the PULSE WIDTH control to 2-μs pulse width on Oscilloscope.

f. If necessary, slip dial to read 2 microseconds.

g. Repeat steps c through f for best overall calibration accuracy.

Note

The width of RF pulse will vary approximately 0.25 μs as the generator is tuned through its RF range. The above adjustments can be made for best accuracy at any desired RF frequency.

5-43. POWER SET METER ADJUSTMENTS.

5-44. MECHANICAL ZERO. Adjust mechanical zero as follows:

a. Remove instrument cover for access to the meter. Lift the white paper sticker that covers the zero adjust. Be sure to replace it when through.

b. Connect shorting lead across meter terminals.

c. With a non-metallic tool, adjust mechanical zero-adjust screw until meter pointer is at left of meter dot and moving towards meter dot; stop adjustment when meter pointer is exactly at dot.

d. Carefully adjust mechanical zero-adjust screw a few degrees to free screw from meter suspension. If pointer moves off dot, repeat step c.

e. Remove shorting lead from meter terminals and replace instrument cover.

5-45. ELECTRICAL ZERO. The electrical zero is set at the factory and requires adjustment only when bolometer circuit components are changed. Adjust as follows:

a. Remove instrument cover for access to R612 (see Figure 5-11).

b. Set MOD. SELECTOR to CW.

c. Adjust POWER SET until meter pointer is about 3/8 inch to the right of zero (0).

d. Set MOD. SELECTOR to OFF.

e. Adjust zero set control (R612) until meter pointer is at the dot at the left end of the scale. Replace the instrument cover.

5-46. TROUBLESHOOTING.

5-47. TEST EQUIPMENT REQUIRED.

5-48. The test equipment required to troubleshoot the Signal Generator is listed in Table 5-2. Instruments other than those listed may be used provided their specifications equal or exceed the critical specifications.

5-49. ISOLATING A TROUBLE TO A CIRCUIT SECTION.

5-50. The troubleshooting procedures are designed to identify the causes of one or more of the following symptoms:

a. Low or no RF output at RF OUTPUTS CAL.

b. RF output normal but abnormal indication on front-panel power meter.

c. No or low amplitude-modulation level.

d. No or little frequency modulation.

e. Modulation frequency, width, or delay abnormal.

f. Poor or no external synchronization.

5-51. Each of the above troubles first requires isolation to a faulty functional section of the Signal Generator. Regardless of the trouble encountered, the power supply voltages should first be checked (see paragraph 5-27). If a power supply is within 4 or 5% of its nominal value, it should not cause any catastrophic trouble. However, a greater deviation from nominal could be suspected as the cause of a near complete failure of a Signal Generator function. If a voltage value exceeds 4% of its nominal level, the power supply should be repaired prior to troubleshooting the other circuits of the instrument.

5-52. POWER SUPPLY TROUBLESHOOTING. Because the individual power supplies are to some extent interdependent, care must be taken to troubleshoot the supplies in a particular sequence. This sequence is as follows: -300 V supply, -700 V supply, -500 V supply, and the 6.3 V filament supplies.

WARNING

Use extreme care when making the filament voltage measurements. One side of each ac supply is connected to a negative high-voltage source. To measure ac voltage, turn off instrument and discharge high-voltage supplies. If one side of voltmeter power line is grounded to voltmeter, remove the ground. Connect voltmeter to test points and turn on instrument. DO NOT TOUCH METER; CASE IS AT HIGH-VOLTAGE POTENTIAL. After measurement, turn off instrument and discharge high-voltage supplies.

5-53. To isolate a trouble in the -300 V supply, check the -300 V output at test point 2. Excessive ripple is probably due to a failure of capacitor, C360, C361, C362, or C363, or a heater-cathode short in V301-V304. If the -300 V output is nonexistent or very low, check the dc voltage between test points 2 and 13 to establish that the dc input to the regulator is normal. If normal, the regulator circuit composed of V301-V304 and associated parts is faulty. Isolate the faulty tube or part through voltage and resistance checks (Figures 5-21, 5-22), and tube replacement. It should be noted that the regulator circuit comprises a servo (feedback) loop, and hence a failure of any part will be reflected by erroneous voltage indications at most points in the circuit. Resistance readings, however, usually provide an indication of a faulty part.

5-54. It should be established that an excessive load is not being placed on the power supplies, such as a shorted high-voltage decoupling capacitor or shorted tube. Excessive load conditions gives trouble symptoms similar to those encountered in a power supply failure. A Model 428B Ammeter can be used to check the current load on the supplies. Table 5-3 lists the check points for each supply.

5-55. If the dc voltage input to the regulator circuit is abnormal, check the ac voltage between test points 3 and 4 (see WARNING in paragraph 5-52). If this voltage is normal, voltage-doubler diodes CR301, CR302, or associated filter parts (C360-C362, R361, R362) are faulty. If the ac voltage across test points 3 and 4 is abnormal, transformer T1 or the 115 (or 230) V primary-power circuit is faulty.

Table 5-3. Power-Supply Current Measurements

Test Point*	Current (mA)
Pink lead connected to TB1-5	7 ±1
Red lead connected to TB1-6	2.3 ±0.5
Red lead connected to TB1-7	4.3 ±0.5

*MOD. SELECTOR set to INT PULSE; frequency adjusted to 7.6 GHz (618C); 11 GHz (620B).

Note

The -700 V and -500 V supplies are checked in a manner similar to the -300 V supply, using the particular test points assigned to these supplies. Care must be taken to follow the sequence given in paragraph 5-52.

5-56. NO OR LOW RF OUTPUT. Assuming the power supply to be normal, no or very low RF output could be caused by a faulty RF attenuator probe, or a faulty klystron and associated components. A faulty attenuator probe can be positively identified by adjusting the POWER SET control to obtain a normal indication on the front panel power meter. If the meter indication is normal, the RF attenuator probe is faulty; otherwise the problem is in the klystron or associated circuit parts. The klystron oscillator is best checked by voltage and current measurements. Refer to Figure 5-22 for klystron voltage measurements and paragraphs 5-30 and 5-32 for measurement of klystron beam current. If all measurements are normal, replace the klystron. Abnormal voltage measurements indicate a failure of one or more circuit parts. If an abnormal indication occurs in the klystron repeller circuit, perform resistance measurements to isolate the faulty part. In the klystron grid circuit, perform resistance checks and check modulator tube V701. In the cathode circuit, check diodes CR701 and CR702.

5-57. RF OUTPUT NORMAL BUT RF OUTPUT METER ABNORMAL. This trouble indication is caused by either a faulty power-monitor probe or power meter circuit. A faulty power-monitor probe is detected by removing diode CR603 and measuring the resistance between center conductor and case. Normal indication is 50 ± 5 ohms. If both the probe and detector check normal, perform voltage checks (see Figure 5-22) on transistors Q601 through Q603 to isolate the faulty part in the power meter circuit.

5-58. NO OR LOW AMPLITUDE MODULATION. To identify this type of trouble first establish that the trouble is with all amplitude-modulation modes (internal pulse, external pulse, or internal square wave) or only one of the modes. If all amplitude modulation modes are faulty, Modulator tube V701 or associated circuit parts are probably faulty. This can be checked by performing waveform measurements at test points 14 and 15 (see Figure 5-27). If the abnormal indication is at test point 14 only, check V701 and the plate circuit components. If both test points are abnormal, check V701 and the grid circuit components. Voltage and resistance checks should isolate a faulty part.

5-59. If the trouble involves only internal pulse modulation, the trouble is in MOD. SELECTOR switch S102 or the internal pulse-generating circuits. To isolate the trouble, check the waveforms (Figure 5-27) at test points 22 through 16, (in that order) and refer to the following list of troubles when an abnormal waveform is encountered.

Abnormal Waveform at Test Point	Trouble
22	V102, V103, or associated parts
21	V105 or associated parts
20	S102, deck H; or V106, V107, or associated parts
19	S102, deck F; or V109 or associated parts
18	V108 or associated parts
17	V111 or associated parts
16	S102, deck E

5-60. If only external pulse modulation is faulty, set MOD. SELECTOR to -EXT and check modulation. If normal, inverter V109A is faulty. If abnormal, switch S102 (sections E or G) is faulty, or capacitor C123 or resistor R143 is faulty. The latter two components may be isolated by checking the external modulating signal at test point 23.

5-61. If only square-wave modulation is faulty, perform waveform measurements at test point 22. If normal, switch S102 (deck G) is faulty. If abnormal, V102, V103, or associated parts are faulty.

5-62. NO OR LITTLE FREQUENCY MODULATION. First establish if the trouble is with both external and internal FM. If the trouble is isolated to external FM only, check waveform (Figure 5-27) at test point 23. If waveform at test point 23 is normal, the trouble is in MOD. SELECTOR switch S102, section B or G. If waveform at test point 23 is abnormal, check capacitor C123 and resistor R143. If trouble is with both external and internal FM, perform waveform measurement at test point 24. If waveform at test point 24 is abnormal check capacitor C136 and variable resistor R168. If waveform at test point 24 is normal, perform voltage and resistance measurements (Figures 5-21, 5-22 of the klystron repeller circuit.

5-63. If only internal FM is faulty, place MOD. SELECTOR to INT FM, check waveform (Figure 5-25) at test points 18 and 21. If indication at both test points is normal, perform voltage and resistance measurements (Figures 5-21, 5-22) on V108B, V110, S102 (section B and D) and coupling capacitor C135. If indication at test point 18 is abnormal, check S102, section F. If indication at test point 21 is abnormal, perform voltage and resistance checks (Figures 5-21, 5-22) of V105 and associated circuit parts.

5-64. MODULATION FREQUENCY, WIDTH, OR DELAY ABNORMAL. A trouble involving the frequency of internal modulation is caused by Multivibrator V102, V103 and associated parts. Pulse width troubles are caused by a fault in Multivibrator V111 or associated parts. Pulse delay troubles are caused by a fault in Multivibrator V106, V107 or associated parts.

5-65. POOR EXTERNAL SYNCHRONIZATION. A trouble involving the external synchronization is caused by Amplifier and Inverter V101 and associated parts. To isolate a trouble in the external synchronization to a faulty part, perform voltage and resistance measurements (Figures 5-21, 5-22) of V101 and associated circuit.

5-66. ISOLATING TROUBLE IN TRANSISTOR CIRCUITS.

5-67. The following procedures and data are given to aid in determining whether a transistor is operational. Tests are given for both in-circuit and out-of-circuit transistors.

5-68. IN-CIRCUIT TESTING.

5-69. The common causes of transistor failures are internal short- and open-circuits. In transistor circuit testing the most important consideration is the transistor base-emitter junction. Like the control grid of a vacuum tube, this is the operational control point in the transistor. This junction is essentially a solid-state diode. For the transistor to conduct, the diode must conduct; that is, the diode must be forward biased. As with simple diodes, the forward-bias polarity is determined by the materials forming the junction. Use the transistor symbol on the schematic diagram to determine the bias polarity required to forward-bias the base-emitter junction. The A part of Figure 5-14 shows transistor symbols with terminals labeled. Notice that the emitter arrow conventionally points toward the type N material. The other two columns of the illustration compare the biasing required to cause conduction and cut-off in transistors and vacuum tubes. If the transistor base-emitter diode (junction) is forward-biased the transistor conducts. If the diode is heavily forward-biased, the transistor saturates. However, if the base-emitter diode is reverse-biased the transistor is cut-off. The voltage drop across a forward biased emitter-base diode varies with transistor collector current. For example, a germanium transistor has a typical forward-bias, base-emitter voltage of 0.2-0.3 V when collector current is 1-10 mA, and 0.4-0.5 V when collector current is 10-100 mA. In contrast, forward bias voltage for silicon transistors is about twice that for germanium types: about 0.5-0.6 V when collector current is low, and about 0.8-0.9 V when collector current is high.

5-70. Figure 5-14, part B, shows simplified versions of the three basic transistor circuits and gives the operating characteristics of each. When examining a transistor stage, first determine if the emitter-base diode is biased for conduction (forward-biased) by measuring the voltage difference between emitter and base. When using an electronic voltmeter, do not measure directly between emitter and base; there may be sufficient loop current between the voltmeter leads to damage the transistor. Instead, measure to a common point (e.g., chassis). If the emitter-base diode is forward-biased, check for amplifier action by short-circuiting base to emitter while observing collector voltage. The short-circuit eliminates base-emitter bias and should cause the transistor to stop conducting (cut off). Collector voltage should then shift to near the supply voltage. Any difference is due to leakage current through the transistor and, in general, the smaller this current, the better the transistor. If collector voltage does not change, the transistor may have an internal open or short.

5-71. TESTING TRANSISTORS WITH AN OHMMETER.

5-72. The two common causes of transistor failure are internal short- and open-circuits. Remove the transistor from the circuit (caution with heat) and use an ohmmeter to measure internal resistance. See Table 5-4, for measurement data.

CAUTION

Most ohmmeters can supply enough current or voltage to damage a transistor. Before using an ohmmeter to measure transistor forward or reverse resistance, check open-circuit voltage and short-circuit current output ON THE RANGE TO BE USED. Open-circuit voltage must not exceed 1.5 V and short-circuit current must be less than 3 mA. See Table 5-5 for safe resistance ranges for some common ohmmeters.

5-73. KLYSTRON REMOVAL (618C).

5-74. To remove the klystron oscillator tube V114 from the resonant cavity proceed as follows:

a. Remove the socket housing cap, screws and lock washers (items 1 and 2, Figure 5-15). Pull the housing (3) away until the tube socket is exposed.

b. Pull straight back on the socket until it is free of the tube base. Do not apply lateral pressure when removing socket.

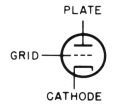
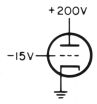
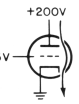
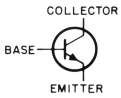
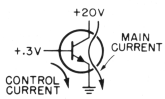
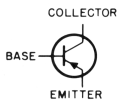
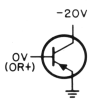
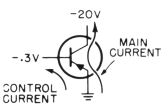
c. Unscrew and remove sleeve (4) which covers klystron body. Do not at any time apply side motion to the klystron; to do so will break the tube.

d. Turn klystron (6) clockwise, and at the same time pull straight back from the cavity. Do not attempt to rock the klystron.

e. Remove rubber washer (14) and clamping ring (5).

f. Unscrew retaining nut (7) at cavity entrance using socket wrench supplied with the instrument. Remove the seating ring (9) and the spring (8) below retaining nut. Do not use this spring or washer again except as a necessity. New springs and washers are supplied with replacement klystrons ordered from Hewlett-Packard Co.

A. TRANSISTOR BIASING

DEVICE	SYMBOL	CUT OFF	CONDUCTING
VACUUM TUBE			
N P N TRANSISTOR			
P N P TRANSISTOR			

B. AMPLIFIER CHARACTERISTICS

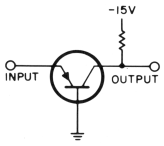
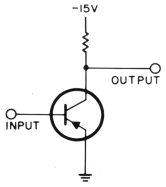
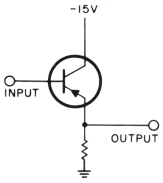
CHARACTERISTIC	COMMON BASE	COMMON EMITTER	COMMON COLLECTOR
INPUT Z	30-50 Ω	500-1500 Ω	20-500K Ω
OUTPUT Z	300-500K Ω	30-50K Ω	50-1000 Ω
VOLTAGE GAIN	500-1500	300-1000	< 1
CURRENT GAIN	< 1	25-50	25-50
POWER GAIN	20-30 dB	25-40 dB	10-20 dB
			

Figure 5-14. Transistor Biasing and Operating Characteristics

Table 5-4. Out-of-Circuit Transistor Resistance Measurement

Transistor Type		Connect Ohmmeter		Measure Resistance (ohms)
		Pos. lead to	Neg. lead to	
PNP Germanium	Small Signal	emitter	base*	200-500
		emitter	collector	10K-100K
	Power	emitter	base*	30-50
		emitter	collector	several hundred
NPN Silicon	Small Signal	base	emitter	1K-3K
		collector	emitter	very high (might read open)
	Power	base	emitter	200-1000
		collector	emitter	high, often greater than 1M

*To test for transistor action, add collector-base short. Measured resistance should decrease.

Table 5-5. Safe Ohmmeter Ranges for Transistor Resistance Measurements

Ohmmeter	Safe Range(s)	Open Ckt Voltage	Short Ckt Current	Lead	
				Color	Polarity
HP 412A	R x 1K	1.0V	1 mA	Red	+
	R x 10K	1.0V	100 μA	Black	-
	R x 100K	1.0V	10 μA		
	R x 1M	1.0V	1 μA		
	R x 10M	1.0V	0.1 μA		
HP 410C	R x 1K	1.3V	0.57 mA		
	R x 10K	1.3V	57 μA	Red	+
	R x 100K	1.3V	5.7 μA	Black	-
	R x 1M	1.3V	0.5 μA		
	R x 10M	1.3V	0.05 μA		
HP 410B	R x 100	1.1V	1.1 mA		
	R x 1K	1.1V	110 μA	Black	+
	R x 10K	1.1V	11 μA	Red	-
	R x 100K	1.1V	1.1 μA		
	R x 1M	1.1V	0.11 μA		
Simpson 260	R x 100	1.5V	1 mA	Red	+
				Black	-
Simpson 269	R x 1K	1.5V	0.82 mA	Black	+
				Red	-
Triplett 630	R x 100	1.5V	3.25 mA	Varies With Serial Number	
	R x 1K	1.5V	325 μA		
Triplett 310	R x 10	1.5V	750 μA		
	R x 100	1.5V	75 μA		

g. If sample probe adapter (11) protrudes into the cavity, remove the lock nut (12) and disengage pipe (10). Loosen lock nut (12) and back out adapter (11) until it is flush with the inside face of the cavity bottom plate.

Note

See Klystron Tube Warranty Claim in this manual.

5-75. KLYSTRON REPLACEMENT (618C).

5-76. Prior to installing a new klystron V114, practice reinstalling the old one. The proper force and twist required to push the klystron past the spring may then be learned by practice. The procedure for installing the new klystron is as follows:

a. Install new waffle seating ring (9, Figure 5-15) and then new spring (8) in cavity entrance. Ends of spring should meet to form a complete circle.

b. Thread the retaining nut (7) into cavity until it is seated very lightly against the spring. Press spring into place under the nut so that it forms a circle. Tighten the nut slightly to hold the spring in position.

CAUTION

When inserting the tube, always keep it straight in line with the cavity. DO NOT work it from side to side.

c. Insert the klystron tube (6) into the cavity until it engages the spring (8). Firmly press the tube straight into the cavity at the same time giving it a clockwise twist. The twist will cause the spring to expand and pass the tube allowing it to seat firmly in the cavity.

d. Tighten the retaining nut slightly with socket wrench supplied.

e. Snap the clamping rings (5) making certain that they encircle the grid ring of the klystron. When the rings are in position, three or four threads of the nut (7) should be visible between the clamping rings and the outside face of the nut. Install rubber washer (14).

f. Thread the cover sleeve (4) into the retaining nut so that it seats against the clamping rings, causing the clamping ring to grip the grid ring of the klystron. Tighten the sleeve firmly by hand.

g. Install the tube socket and housing (3), pressing the socket straight into position.

h. Position socket housing and attach cap screws (1).

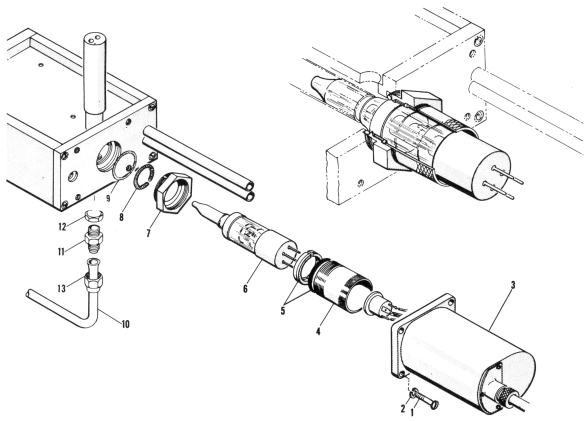


Figure 5-15. Exploded View of Klystron Mounting Parts (618C)

5-77. KLYSTRON REMOVAL (620B).

5-78. To remove the klystron from the resonant cavity, remove the Instrument from the cabinet or rack.

The klystron is located at the left side of the instrument just behind the front panel. Refer to Figure 5-16 and proceed as follows:

CAUTION

Do not at any time apply side pressure to the klystron. To do so will break the tube.

a. Remove the four screws from the klystron tube base cover.

b. Pull tube base cover straight out to expose tube base.

c. Remove socket from klystron. Pull socket straight out to expose tube base.

d. Loosen and remove klystron mounting nut with wrench supplied.

e. Remove collet washer with a sharp tool. Grasp klystron tube base and pull straight out of cavity.

f. Remove clamp spring.

g. If collet ring and collet are locked on klystron, place klystron on its base and gently tap collet ring to free the collet.

Note

See Klystron Tube Warranty Claim at rear of Replaceable Parts.

5-79. KLYSTRON REPLACEMENT (620B).

a. Insert waffle washer in cavity (Figure 5-16). Use new washer if old washer is damaged.

b. Place collet ring and collet spring on collet, making sure taper on ring seats against flare of collet.

c. Place collet washer over collet. Place mounting nut over collet washer.

d. Place klystron assembly into cavity and tighten mounting nut by hand until collet just grips klystron, but klystron should still be free to rotate.

f. Slide klystron out approximately 1/8 inch, then push in until klystron seats firmly against shoulder in collet.

CAUTION

DO NOT USE EXCESSIVE PRESSURE, to prevent possible damage to klystron.

g. Tighten mounting nut by hand, then push socket on klystron base, being careful not to exert any side pressure on the klystron.

h. Remove cover plate from frequency drive mechnism to check repeller cable. Be sure to push the repeller cable into center conductor to connect the repeller before turning on the instrument.

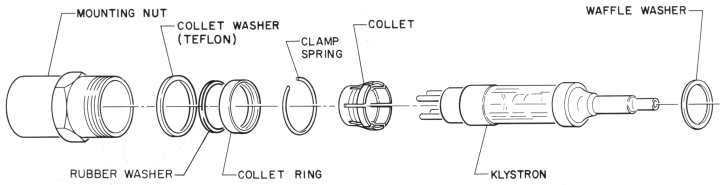


Figure 5-16. Exploded View of Klystron Mounting Parts (620B)

CAUTION

Failure to make repeller connection may cause damage to klystron.

i. Complete klystron adjustment is given in step a through h of paragraph 5-32.

5-80. REPLACING REPELLER TRACKING POTENTIOMETER.

5-81. To replace the repeller tracking potentiometer, R174, on the frequency drive casting, refer to Figure 5-17 and proceed as follows:

a. Remove the four flat-heat screws on each side of the front panel that hold the panel assembly to the side gussets. Pull panel assembly away from chassis to give access to the repeller potentiometer.

b. Remove leads from terminals on potentiometer.

c. Remove Tru-Arc ring and potentiometer rear cover.

d. Loosen only the two setscrews holding potentiometer shaft in the coupler. Do not loosen screws holding coupler to front-panel shaft.

e. Remove the three screws holding the potentiometer to the mounting ring and withdraw potentiometer. Do not loosen screws holding mounting ring to casting.

f. Remove rear cover and place shaft of new potentiometer in coupler. Do not tighten the set screws at this time.

g. Position the new potentiometer with the terminals near the top and replace the three mounting screws and spacers. Position the potentiometer so that shaft does not bind in coupler during any portion of coupler rotation. Tighten mounting screws.

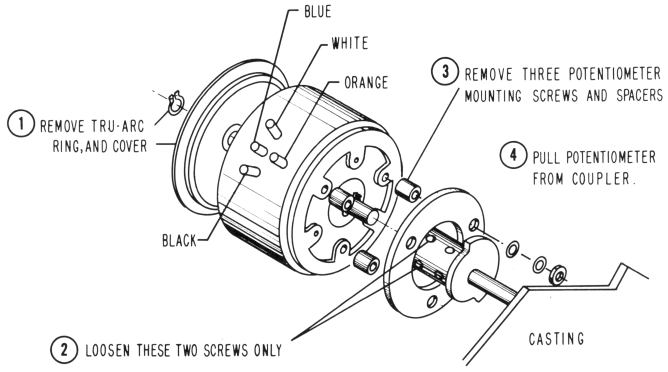


Figure 5-17. Repeller Tracking Potentiometer Removal

h. With an ohmmeter connected between the orange and blue leads on the potentiometer, turn the frequency control to point where microswitch just operates (approximately 8.9 GHz), so the arm (blue lead) is exactly at the tap in the potentiometer. This point is the lowest resistance reading on ohmmeter.

i. Replace rear potentiometer cover and reconnect leads.

j. Tighten set screws in the coupler.

k. Reset repeller voltage adjustments as described in paragraphs 5-33 and 5-35.

5-82. REPLACING AND RECALIBRATING THE ATTENUATOR (618C).

5-83. It is not expected that the attenuator dial will require recalibration unless the attenuator assembly is replaced. The attenuator is not ordinarily subject to change or breakage. Small improvements in accuracy may be made by slipping the attenuator dial on the front panel slightly on its shaft to bring into calibration.

5-84. Following replacement of the probe, the attenuator assembly must be adjusted for the correct and safe operating depth. The following instructions are divided into two parts: the first concerns the replacement of the attenuator probe, and the second concerns the attenuator dial alignment.

5-85. REPLACING THE ATTENUATOR PROBE (618C).

5-86. Power from the resonator is coupled to the RF OUTPUTS CAL jack at the front panel through an assembly consisting of the panel jack, a length of RG-55 U cable, and the attenuator probe. The attenuator probe is terminated by a special resistor, which is made by coating platinum on a glass bead. This resistor should normally last for the life of the equipment even if subject to shock and vibration. Should the resistor become broken or otherwise defective however, the complete attenuator assembly must be replaced. Replace a defective attenuator assembly as follows:

a. Remove the four screws holding the RF OUTPUTS CAL connector to the front panel.

b. Release attenuator cable from under cable clamp.

c. Remove mounting screw which holds the rack to the aluminum block on the attenuator probe.

d. Lift mounting block and probe from the circular waveguide housing.

e. Use care in handling attenuator probes. The glass bead resistor can be broken by twisting the cable. Mounting block comes affixed to new probe.

f. Insert new probe into waveguide only as far as is necessary to match-up block mounting holes. Insert mounting screw and tighten. Take care that the probe ground is oriented in the right direction (away from the cavity). The glass beads should be visible on the RIGHT HAND SIDE of the ground connection extension when viewing the instrument from the front.

g. Carefully thread cable under cable clamp and around casting to front panel. Avoid twisting cable more than one-quarter turn.

h. Remount RF OUTPUTS CAL connector. Tighten cable clamp.

i. After the assembly is replaced, an error of a few decibels may exist in the calibration of the attenuator dial.

5-87. RECALIBRATING THE ATTENUATOR (618C).

a. Connect signal generator in test setup shown in Figure 5-1.

b. Turn signal generator on and allow a 20-minute warm up period with modulation selector switch in CW position.

c. Turn modulation selector switch to OFF position, adjust zero set controls in generator and power meter to zero, and return selector switch to CW position. To prevent drift due to temperature change make these adjustments as quickly as possible.

d. Tune signal generator to 3.8 GHz and adjust POWER SET control for zero indication on power set meter.

e. Set attenuator to 7 (-7 dBm). Record frequency and external power meter reading.

f. Repeat step e every 200 MHz across entire frequency range.

g. Plot a dBm-frequency curve from readings obtained in step f (see Figure 5-18). Resulting response curve will consist of a series of peaks and troughs having an amplitude of ±2.0 dB or less. Draw a straight line (parallel to frequency axis) through response curve in such a way that variations are averaged about the line.

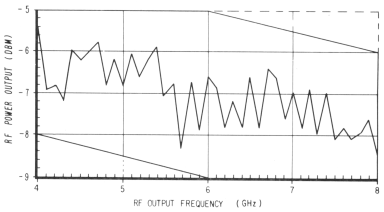


Figure 5-18. Typical Response Curve (618C)

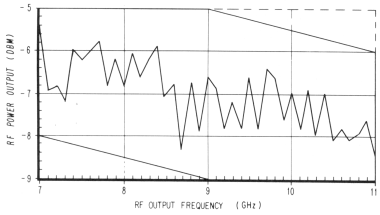


Figure 5-19. Typical Response Curve (620B)

h. Select a frequency where response curve crosses average line drawn in step g and set generator to this frequency.

i. Repeat step c.

j. Set generator output attenuator for -7 dBm reading on power meter and lock attenuator. If attenuator dial does not now read 7 (-7 dBm), remove plate covering hub of dial, loosen set screws holding dial to shaft and slip dial to read -7 dBm. Tighten set screws and replace plate over hub of dial.

k. Repeat steps c and j without changing generator frequency. The readings obtained on external power meter and from output attenuator should be the same. If not, repeat steps c and j until normal indications are obtained.

5-88. REPLACING AND RECALIBRATING THE ATTENUATOR (620B).

5-89. It is not expected that the attenuator dial will require recalibration unless the attenuator assembly is replaced. The attenuator is not ordinarily subject to change or breakage. Small improvements in accuracy may be made by slipping the attenuator dial on the front panel slightly on its shaft to bring into calibration. Following the replacement of the probe, the attenuator assembly must be adjusted for the correct and safe operating depth. The following operation is divided into two parts. The first concerns the replacement of the attenuator probe, and the second concerns the recalibration of the attenuator dial. To determine if the output attenuator is defective, measure the resistance between the center terminal of the RF OUTPUT jack and ground. The resistance should be approximately 50 ohms. A higher resistance indicates the film resistor that composes part of the pickup loop is damaged and the attenuator probe and cable must be replaced.

5-90. REPLACING THE ATTENUATOR PROBE (620B).

5-91. To replace the attenuator probe assembly, proceed as follows:

a. With the signal generator removed from its rack or cabinet and disconnected from the line source, remove nut from rear of the RF OUTPUTS CAL connector and pull attenuator cable from the jack. The center connector and spacing beads are removed with the cable. A new replacement assembly includes these parts already installed.

b. Free the attenuator cable from small clamp and feed cable out top of instrument noting the routing of the cable around the various decks.

c. Mark the attenuator cable where the cable enters the attenuator mounting block. Loosen the cap screw shown in Figure 5-20 on the mounting block holding the attenuator cable. Pull probe straight out.

d. Compare the new probe with the defective probe, marking the new probe at the same distance from the tip as the mark on the defective probe. Insert new probe carefully to the same depth as the original probe making sure that the ground end of the pickup loop points toward the resonator cavity (to the right when facing the Instrument).

e. Tighten cap screw finger-tight so that minor adjustment of the probe depth is still possible.

f. Carefully thread the cable under the cable clamp and around the casting to the front panel. DO NOT twist cable more than a quarter of a turn.

g. Remount RF OUTPUTS CAL connector. Tighten cable clamp.

h. After the attenuator assembly is replaced, an error of a few dB may exist in the calibration of the attenuator dial. Calibration may be checked as described in the following paragraph.

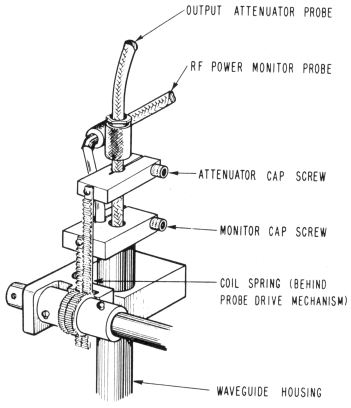


Figure 5-20. Attenuator and Monitor Probe Assemblies (620B)

5-92. RECALIBRATING THE ATTENUATOR (620B).

a. Connect Signal Generator in test setup shown in Figure 5-1. Allow Signal Generator to warm up with MOD. SELECTOR in CW position for at least twenty minutes.

b. Set MOD. SELECTOR to OFF.

c. Adjust Signal Generator to 9 GHz.

d. Connect Power Meter to RF OUTPUT CAL connector; zero meter reading on Power Meter.

e. Set MOD. SELECTOR to CW.

f. Adjust POWER SET control so that the front-panel power meter reads 0.

g. Adjust the OUTPUT ATTEN control to -7 dBm.

WARNING

High voltage is present on the green lead below the attenuator assembly and at the terminals on the potentiometer above the frequency-drive casting. Be extremely careful not to touch these components when adjusting the attenuator probe with the instrument turned on.

h. Gently adjust the probe depth so that the external power meter indicates -7 dBm. Tighten the cap screw on the attenuator probe.

5-93. An initial setting has now been made that will be accurate within approximately ±5 dB. To refine this setting and obtain the original calibration accuracy of ±2 dB it is necessary to measure the output of the signal generator across the frequency range and construct a graph showing the frequency response of the instrument. Figure 5-19 shows such a graph with a typical response curve after the power output curve has been centered about the -7 dBm reference level. The final adjustment is made by slipping the attenuator dial, while measuring the RF output level at a convenient frequency on the curve, to bring the total power spread to be within the ±2 dB limits of the -7 dBm reference level. The limits are indicated by the heavy transverse lines above and below the -7 dBm center line. Proceed as follows:

a. Assuming the Signal Generator is at normal operating temperature, set MOD. SELECTOR to OFF and zero the external power meter.

b. Set MOD. SELECTOR to CW and tune frequency dial to 7 GHz.

c. Adjust POWER SET control so that Meter indicates 0.

d. Check that OUTPUT ATTEN control is set to -7 dBm.

e. Record the reading on the external Power Meter.

f. Repeat steps c through e every 200 MHz from 7 GHz to 11 GHz. Plot the resulting data as a response curve such as the one shown in Figure 5-19.

g. This curve should consist of a series of peaks and troughs with a maximum range of ±2 dBm.

h. Equalize the maximum excursions on each side of -7 dBm by slipping the attenuator dial. The dial is made free of the drive shaft by removing the hub cover from the center of the attenuator dial and loosening the two Allen screws in the periphery of the hub.

5-94. TUBE AND SEMICONDUCTOR REPLACEMENT.

5-95. Table 5-6 lists checks to be made after replacement of certain electron tubes and semiconductors (e.g., diodes, transistors). Replacement of unlisted items does not affect critical Signal Generator functions or operating voltages.

Note

Do not change an operating voltage or calibration adjustment unless it is either definitely outside specified tolerance or calibration accuracy of a dependent function is unsatisfactory. Improving a marginal adjustment can adversely affect calibration.

5-96. ETCHED CIRCUITS.

5-97. The etched circuit boards in the Signal Generator are of the plated-through type consisting of metallic conductors bonded to both sides of insulating material. The metallic conductors are extended through the component mounting holes by a plating process. Soldering can be done from either side of the board with equally good results. Table 5-7 lists recommended tools and materials. Following are recommendations and precautions pertinent to etched circuit repair work.

a. Avoid unnecessary component substitution; it can result in damage to the circuit board and/or adjacent components.

b. Do not use a high-power soldering iron on etched circuit boards. Excessive heat may lift a conductor or damage the board.

c. Use a suction device (Table 5-7) or wooden toothpick to remove solder from component mounting holes. DO NOT USE A SHARP METAL OBJECT SUCH AS AN AWL OR TWIST DRILL FOR THIS PURPOSE. SHARP OBJECTS MAY DAMAGE THE PLATED-THROUGH CONDUCTOR.

d. After soldering, remove excess flux from the soldered areas and apply a protective coating to prevent contamination and corrosion. See Table 5-7 for recommendations.

e. When removing a multiple-connection component held tightly in a socket, such as a vacuum tube, loosen it gradually using gentle side-to-side or rotary motion to avoid damage to the plated-through conductors.

Table 5-6. Checks Following Tube and Semiconductor Replacement

Reference Designation	Check	Paragraphs
V103	PULSE RATE control calibration	5-33
V107	PULSE DELAY control calibration	5-35
V111	PULSE WIDTH control calibration	5-37
V114	Klystron frequency, current and voltage	5-29
V301 thru V305	-300V supply voltage	5-27
V401 thru V405	-1000V supply voltage	5-27
V501 thru V504	-1500 supply voltage	5-27
CR601 thru CR602	Power meter calibration	5-39
Q601 thru Q603	Power meter calibration	5-39

5-98. COMPONENT REPLACEMENT.

a. Remove defective component from circuit board.

Note

Axial lead components, such as resistors and tubular capacitors, can be replaced without unsoldering. Clip leads near body of defective component, remove component and straighten leads left in board. Wrap leads of replacement component one turn around original leads. Solder wrapped connection, and clip off excess lead.

b. Remove solder from mounting holes using a suction desoldering aid (Table 5-7) or wooden toothpick.

c. Shape leads of replacement component to match mounting hole spacing.

d. Insert component leads into mounting holes, and position component as original was positioned. DO NOT FORCE LEADS OF REPLACEMENT COMPONENT INTO MOUNTING HOLES. Sharp lead ends may damage plated-through conductor.

Table 5-7. Etched Circuit Soldering Equipment

Item	Use	Specification	Item Recommended
Soldering Tool	Soldering Unsoldering	Wattage rating: 37.5 Tip Temp: 750-800°F Tip Size: 1/8" OD	Ungar #776 Handle with Ungar #1237 Heating Unit
Soldering Tip, general purpose	Soldering Unsoldering	Shape: chisel Size: 1/8"	Ungar #PL113
De-soldering aid	Unsoldering multi-connection components (e.g., tube sockets)	Suction device to remove molten solder from connection	Soldapult by the Edsyn Company, Arleta, California
Resin (flux) solvent	Remove excess flux from soldered area before application of protective coating	Must not dissolve etched circuit base board material or conductor bonding agent	Freon Acetone Lacquer Thinner Isopropyl Alcohol (100% dry)
Solder	Component replacement Circuit board repair Wiring	Resin (flux) core, high tin content (60/40 tin/lead), 18 gauge (SWG) preferred	
Protective Coating	Contamination, corrosion protection after soldering	Good electrical insulation, corrosion-prevention properties	Krylon® #1302* Humiseal Protective Coating, Type 1B12 by Columbia Technical Corp. Woodside 77, New York

*Krylon, Inc., Norristown, Pennsylvania

5-99. TUBE SOCKET REPLACEMENT. There are three ways to remove a tube socket from the etched circuit boards:

a. Cut terminals attaching socket to circuit board, remove socket, and unsolder remaining terminal pieces individually.

b. Using long nose pliers, break insulating material of socket away from metal connectors, then unsolder connectors from board individually.

c. Use a special soldering iron tip designed to heat all socket connections simultaneously and remove socket as a unit; or use a suction device (Table 5-7) to desolder all connections and remove socket.

5-100. ETCHED CONDUCTOR REPAIR. A broken or burned section of conductor can be repaired by bridging the damaged section with a length of tinned copper wire. Allow adequate overlap and remove any varnish from etched conductor before soldering wire into place.

5-101. TRANSISTOR AND SEMICONDUCTOR DIODE REPLACEMENT.

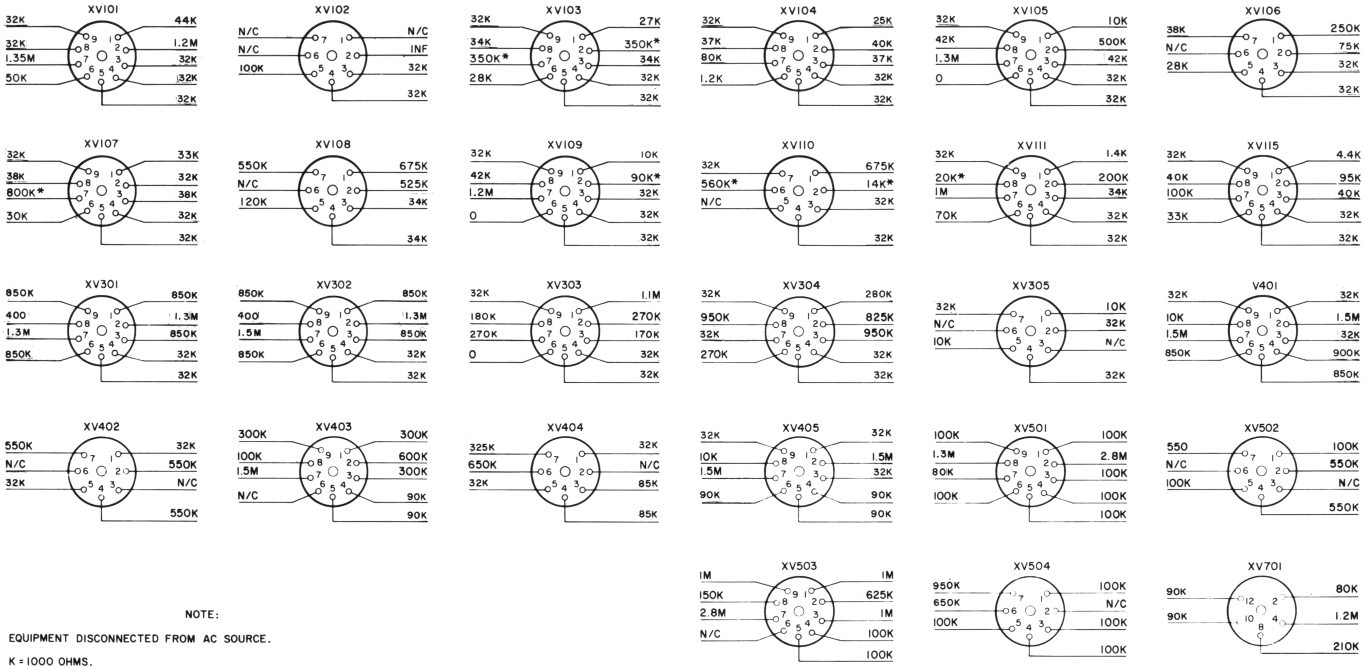
a. Do not apply excessive heat. See Table 5-7 for soldering tool specifications.

b. Use a heat sink such as pliers or hemostat between transistor body and hot soldering iron.

c. When installing a replacement transistor, ensure sufficient lead length to dissipate heat of soldering by maintaining about the same length of exposed lead as used for original transistor.

5-102. Q601, Q602 LEAD IDENTIFICATION.

5-103. Transistors Q601 and Q602 are dual transistors (i.e., two transistors in one case). For this configuration, the locating tab which protrudes from the rim of the transistor case identifies the collector, not the emitter.



NOTE:

EQUIPMENT DISCONNECTED FROM AC SOURCE.

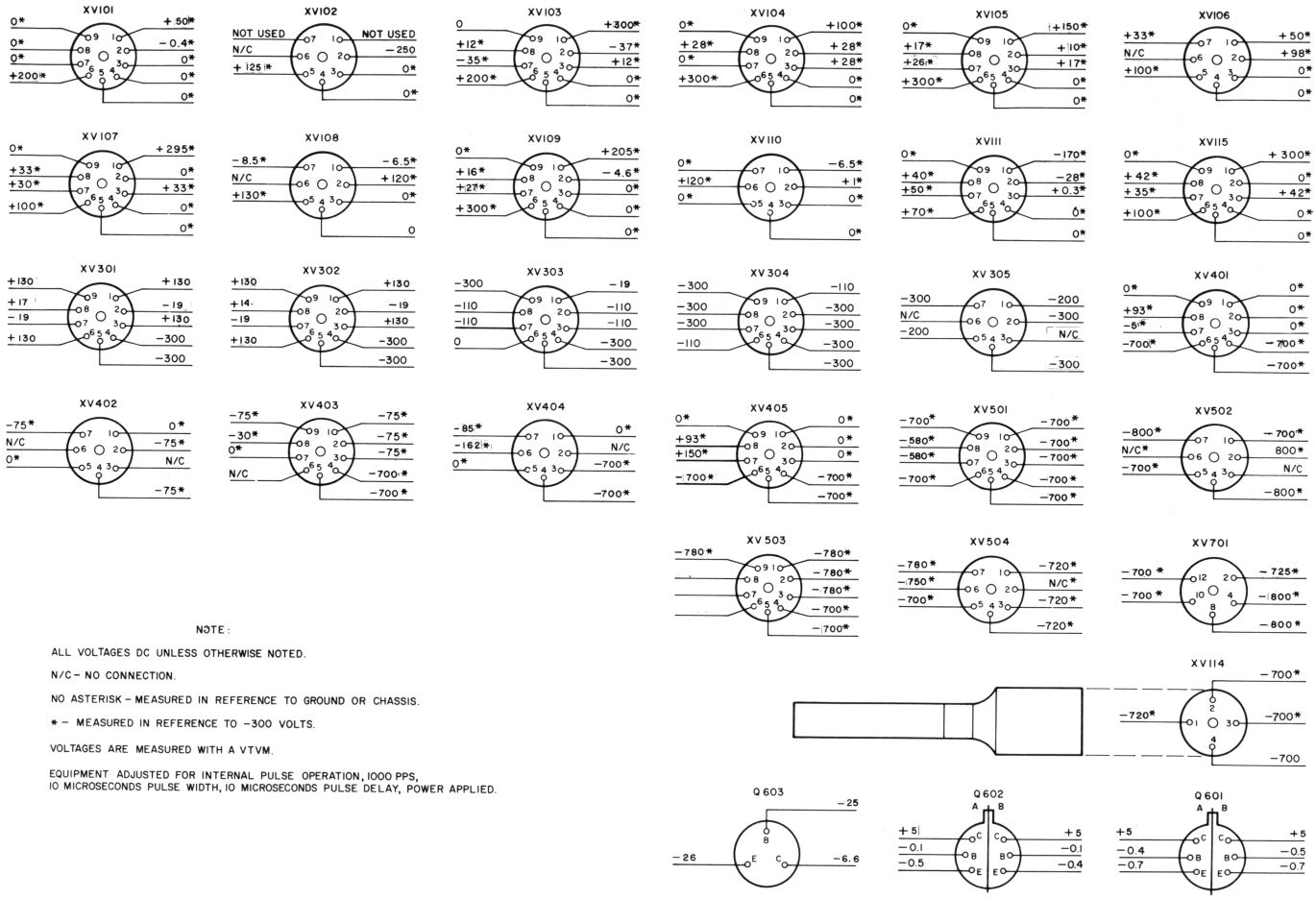
K = 1000 OHMS.

M = MEGOHMS.

MEASUREMENTS MADE WITH VTVM, USING SCALE THAT GIVES READING CLOSEST TO CENTER OF SCALE, REFERENCE TO GROUND, OR CHASSIS.

* THESE VALUES WILL VARY WITH THE SETTINGS OF THE FRONT PANEL CONTROLS.

Figure 5-21. Resistance Chart



NOTE:

ALL VOLTAGES DC UNLESS OTHERWISE NOTED.

N/C – NO CONNECTION.

NO ASTERISK – MEASURED IN REFERENCE TO GROUND OR CHASSIS.

* – MEASURED IN REFERENCE TO -300 VOLTS.

VOLTAGES ARE MEASURED WITH A VTVM.

EQUIPMENT ADJUSTED FOR INTERNAL PULSE OPERATION, 1000 PPS, 10 MICROSECONDS PULSE WIDTH, 10 MICROSECONDS PULSE DELAY, POWER APPLIED.

Figure 5-22. Voltage Chart

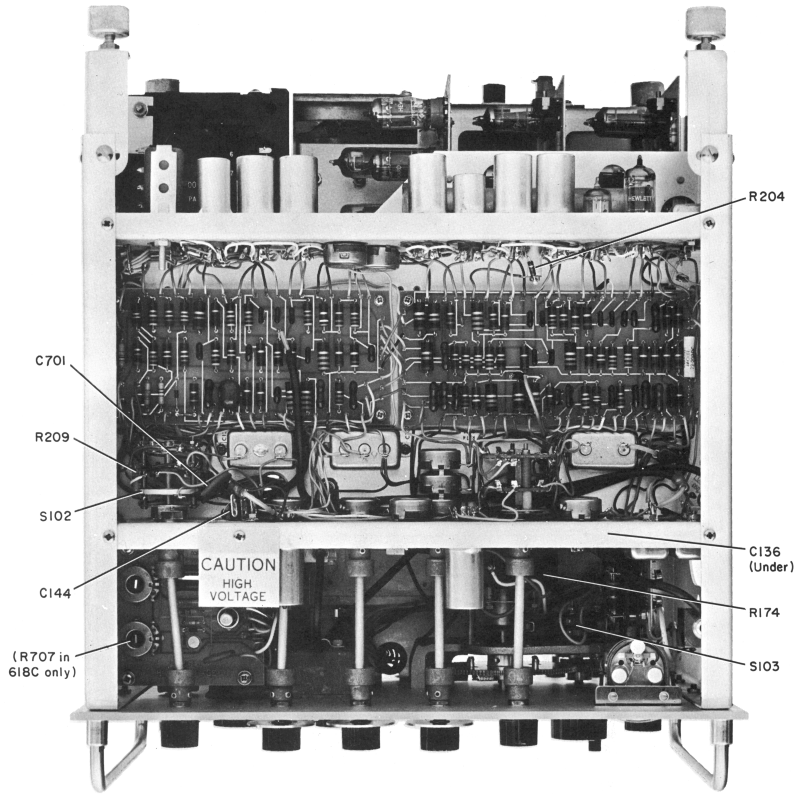


Figure 5-23. Interior View Showing Locations of Unlabeled Chassis Components (Top View)

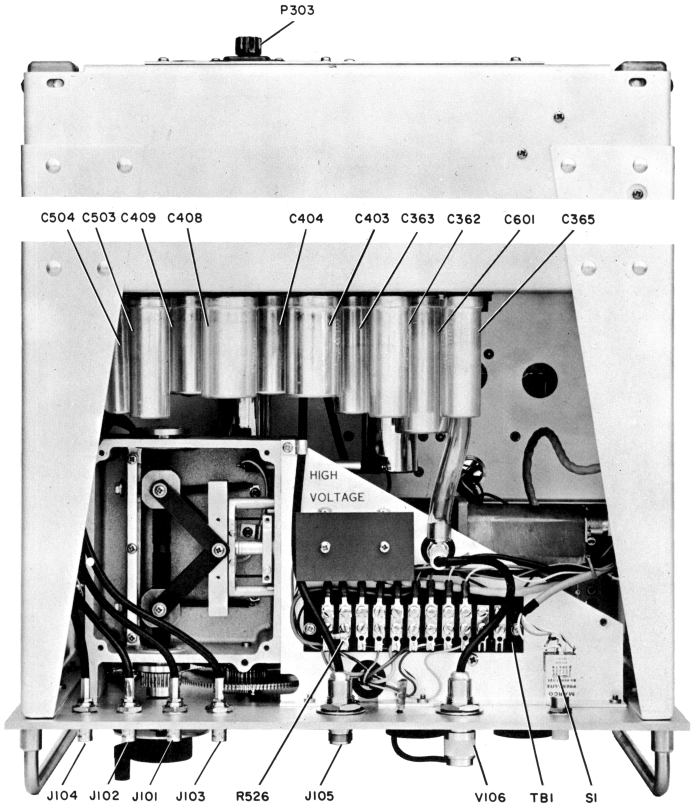


Figure 5-24. Component Identification, Bottom Interior View

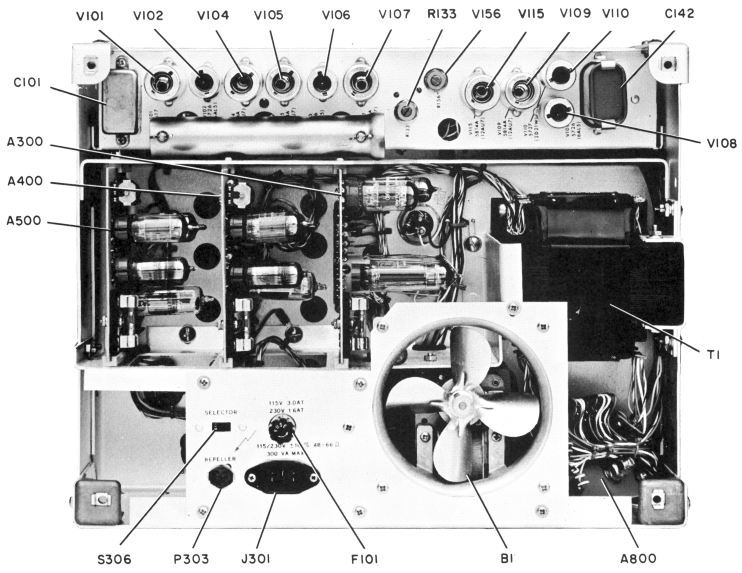


Figure 5-25. Component Identification, Rear Interior View

1. Resistance in ohms, capacitance in microforads unless otherwise noted

2. screwdriver adjust

3. front panel designation

4. test point

5. voltage regulator (breakdown) diode

6. Encloses wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number identifies the base color, second number the wider stripe, and the third number identifies the narrower stripe. E.G., 947 denotes white base, yellow wide stripe, violet narrow stripe.

7. Waveform taken with Oscilloscope adjusted for ac coupling

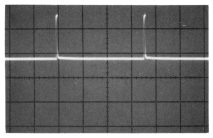
8. Except for test point 23, all waveforms taken with front panel controls set as follows:

   MOD SELECTOR - INT
   PULSE WIDTH - 10
   PULSE DELAY - 0
   PULSE RATE - 200
   FM AMPLITUDE - Fully cw

9. Waveform taken at test point 23 taken with front panel controls set as listed in note 7 except MOD SELECTOR is set to INT FM.

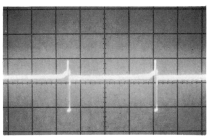
10. Voltages shown on schematic diagrams are with respect to chassis ground.

Figure 5-26. Notes Pertaining to Waveform and Schematic Diagrams



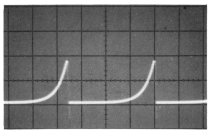
Test Point 14
(Notes 7
and 8)

0.2 MS/CM
0.2 V/CM



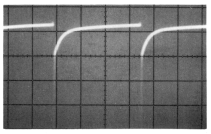
Test Point 15
(Notes 7
and 8)

0.2 MS/CM
2 V/CM



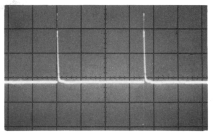
Test Point 16
(Notes 7
and 8)

0.2 MS/CM
0.05 V/CM



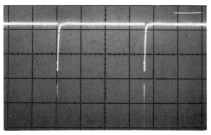
Test Point 17
(Notes 7
and 8)

0.2 MS/CM
0.5 V/CM



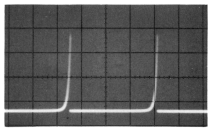
Test Point 18
(Notes 7
and 8)

0.2 MS/CM
2 V/CM



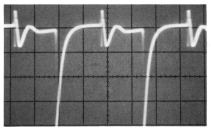
Test Point 19
(Notes 7
and 8)

0.2 MS/CM
0.2 V/CM



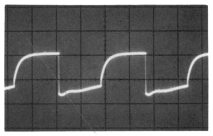
Test Point 20
(Notes 7
and 8)

0.2 MS/CM
0.5 V/CM



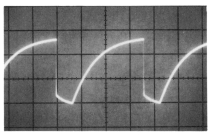
Test Point 21
(Notes 7
and 8)

0.2 MS/CM
0.1 V/CM



Test Point 22
(Notes 7
and 8)

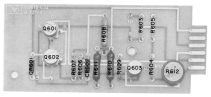
0.2 MS/CM
5 V/CM



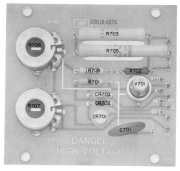
Test Point 24
(Notes 7
and 9)

0.2 MS/CM
5 V/CM

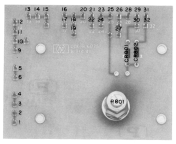
Figure 5-27. Waveforms



Component Identification, A600



Component Identification, A700



Component Identifications, A800

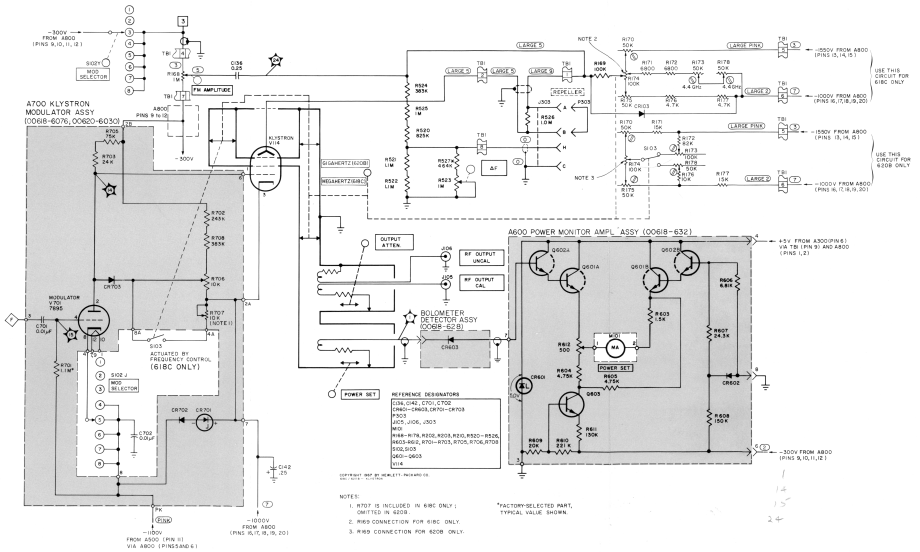
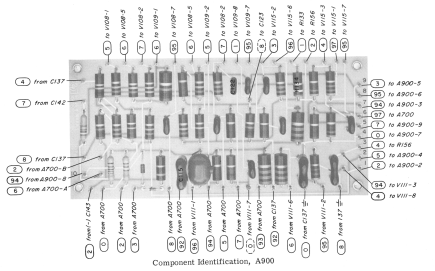
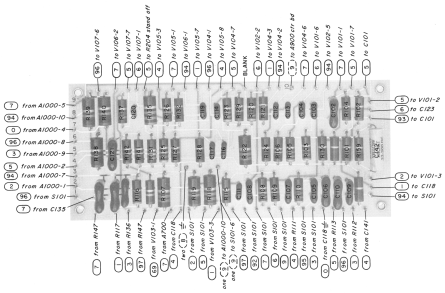

A700 KLYSTRON MODULATOR ASSY (00618-6070, 00620-6030)
A600 POWER MONITOR AMPL ASSY (00618-632)
BOLOMETER DETECTOR ASSY (00618-628)
REFERENCE DESIGNATORS
NOTES:
1. R707 IS INCLUDED IN 618C ONLY; OMITTED IN 620B.
2. R169 CONNECTION FOR 618C ONLY.
3. R169 CONNECTION FOR 620B ONLY.
*FACTORY-SELECTED PART, TYPICAL VALUE SHOWN.

Figure 5-28. Klystron Section

Figure 5-28.
KLYSTRON SECTION



Component Identification, A900



Component Identification, A1000

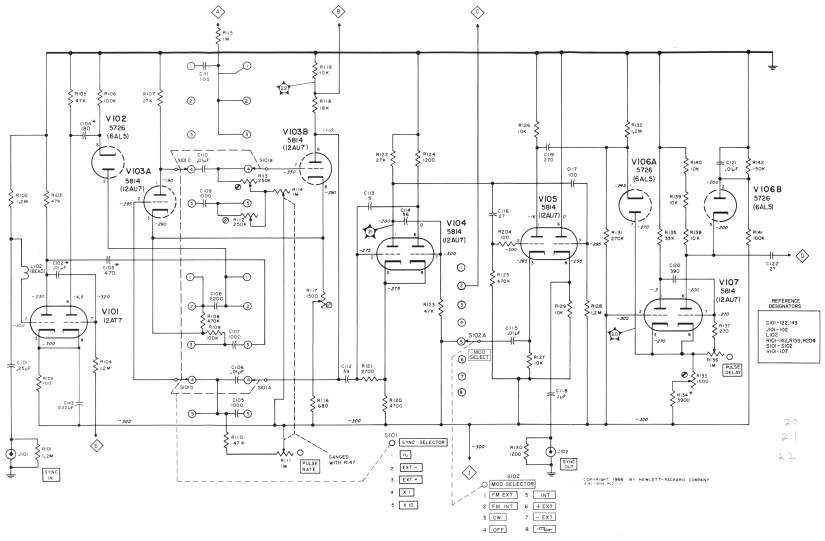
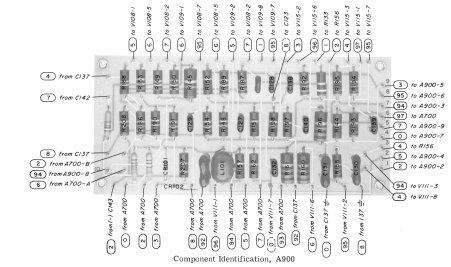
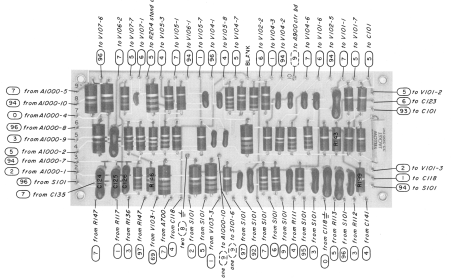


Figure 5-29. Modulator Section (Part 1 of 2)

Figure 5-29.
MODULATOR SECTION (Part 1 of 2)



Component Identification, A900



Component Identification, A1000

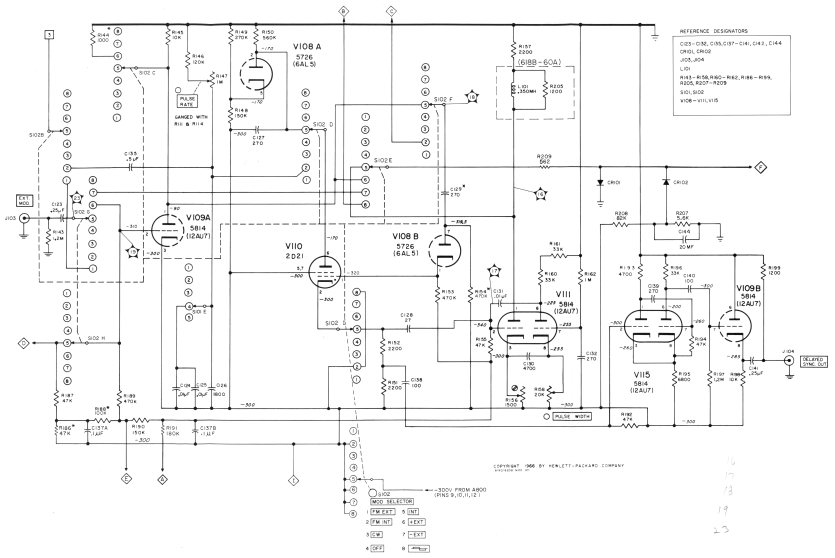
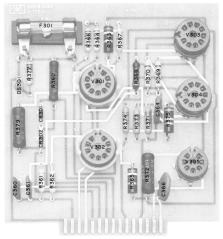
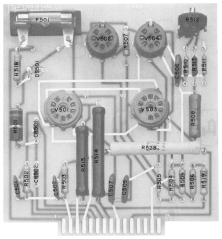


Figure 5-30. Modulator Section (Part 2 of 2)

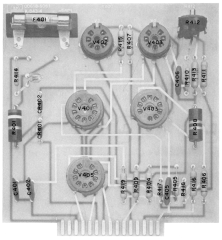


Component Identification A300

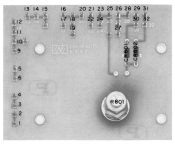


Component Identification A500

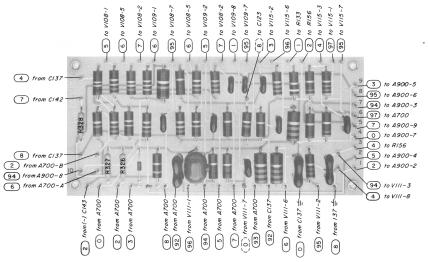
Figure 5-30.
MODULATOR SECTION (Part 2 of 2)
5-35



Component Identification, A400



Component Identification, A800



Component Identification, A900

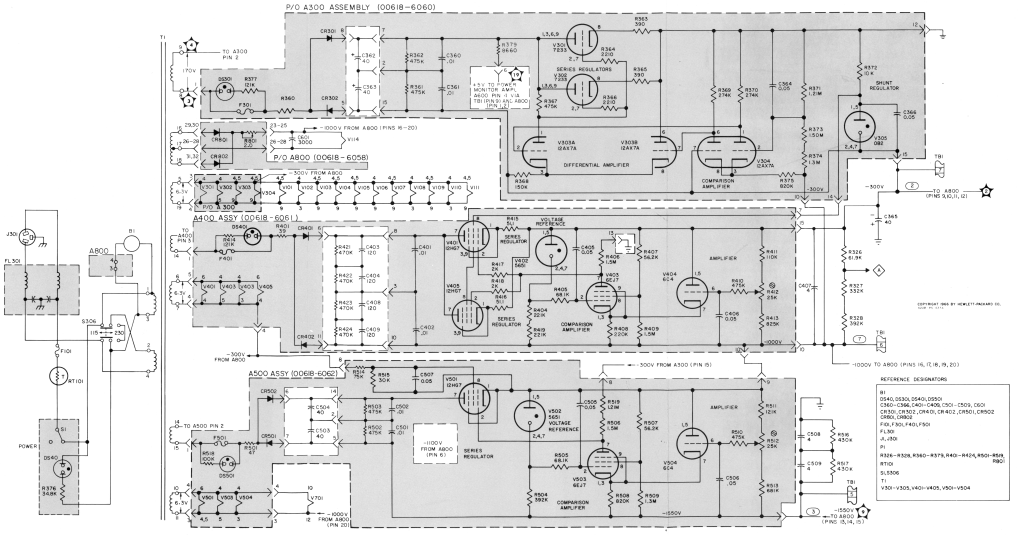


Figure 5-31. Power Supply Section

Figure 5-31.
POWER SUPPLY SECTION

SECTION VI
REPLACEABLE PARTS

6-1. INFORMATION.

6-2. This section contains information for ordering replaceable parts. Table 6-1 gives the meanings of abbreviations and reference designations used in the table of replaceable parts. Table 6-2 is the table of replaceable parts and is organized as follows:

a. Electrical assemblies and their component parts in alpha-numerical order by reference designation.

b. Chassis-mounted parts in alpha-numerical order by reference designation.

c. Miscellaneous parts.

6-3. The information given for each part consists of:

a. The Hewlett-Packard part number.

b. Total quantity in the instrument.

c. Description of the part.

d. Typical manufacturer of the part in a 5-digit code.

e. The manufacturer's number for the part.

Total quantity for each part is given only once - at the first appearance of the part number.

6-4. Table 6-3 contains the names and addresses that correspond to the manufacturer's code numbers.

6-3. ORDERING INFORMATION.

6-6. To order a replacement part, address order or inquiry to your local Hewlett-Packard sales and service office (see lists at rear of this manual).

6-7. Specify the following information for each part:

a. Model and complete serial number of instrument.

b. Hewlett-Packard part number.

c. Circuit reference designation.

d. Complete description of part.

Table 6-1. Reference Designations and Abbreviations

REFERENCE DESIGNATORS

A	= assembly	F	= fuse	P	= plug	V	= vacuum tube, neon bulb, photocell, etc.
B	= motor	FL	= Filter	Q	= transistor		
BT	= battery	J	= jack	R	= resistor		
C	= capacitor	K	= relay	RT	= thermistor	VR	= voltage regulator
CP	= coupler	L	= inductor	S	= switch		
CR	= diode	LS	= loud speaker	T	= transformer	W	= cable
DL	= delay line	M	= meter	TB	= terminal board	X	= socket
DS	= device signaling (lamp)	MK	= microphone	TP	= test point	Y	= crystal
E	= misc electronic part	MP	= mechanical part	U	= integrated circuit	Z	= tuned cavity, network

ABBREVIATIONS

A	= amperes	H	= henries	N/O	= normally open	RMO	= rack mount only
AFC	= automatic frequency control	HDW	= hardware	NOM	= nominal	RMS	= root-mean square
		HEX	= hexagonal	NPO	= negative positive zero (zero temperature coefficient)	RWV	= reverse working voltage
AMPL	= amplifier	HG	= mercury			S-B	= slow-blow
		HR	= hour(s)			SCR	= screw
BFO	= beat frequency oscillator	Hz	= Hertz	NPN	= negative-positive-negative	SE	= selenium
						SECT	= section(s)
BE CU	= beryllium copper	IF	= intermediate freq	NRFR	= not recommended for field replacement	SEMICON	= semiconductor
BH	= binder head	IMPG	= impregnated			SI	= silicon
BP	= bandpass	INCD	= incandescent			SIL	= silver
BRS	= brass	INCL	= include(s)			SL	= slide
BWO	= backward wave oscillator	INS	= insulation(ed)	NSR	= not separately replaceable	SPG	= spring
		INT	= internal			SPL	= special
				OBD	= order by description	SST	= Stainless steel
CCW	= counterclockwise	K	= kilo = 1000			SR	= split ring
CER	= ceramic			OH	= oval head	STL	= steel
CMO	= cabinet mount only			OX	= oxide		
COEF	= coefficient	LH	= left hand				
COM	= common	LIN	= linear taper	P	= peak	TA	= tantalum
COMP	= composition	LK WASH	= lock washer	PC	= printed circuit	TD	= time delay
COMPL	= complete	LOG	= logarithmic taper	PF	= picofarads = 10^{-12} farads	TGL	= toggle
CONN	= connector	LPF	= low pass filter			THD	= thread
CP	= cadmium plate			PH BRZ	= phosphor bronze	TI	= titanium
CRT	= cathode-ray tube			PHL	= Phillips	TOL	= tolerance
CW	= clockwise	M	= milli = 10^{-3}	PIV	= peak inverse voltage	TRIM	= trimmer
		MEG	= meg = 10^{6}			TWT	= traveling wave tube
DEPC	= deposited carbon	MET FLM	= metal film	PNP	= positive-negative-positive		
DR	= drive	MET OX	= metallic oxide				
		MFR	= manufacturer	P/O	= part of		
ELECT	= electrolytic	MHz	= mega Hertz	POLY	= polystrene	μ	= micro = 10^{-6}
ENCAP	= encapsulated	MINAT	= miniature	PORC	= porcelain		
EXT	= external	MOM	= momentary	POS	= position(s)	VAR	= variable
		MOS	= metalized substrate	POT	= potentiometer	VDCW	= dc working volts
F	= farads			PP	= peak-to-peak		
FH	= flat head	MTG	= mounting	PT	= point	W/	= with
FIL H	= Fillister head	MY	= "mylar"	PWV	= peak working voltage	W	= watts
FXD	= fixed					WIV	= working inverse voltage
		N	= nano (10^{-9})	RECT	= rectifier		
G	= giga (10^{9})	N/C	= normally closed	RF	= radio frequency	WW	= wirewound
GE	= germanium	NE	= neon	RH	= round head or right hand	W/O	= without
GL	= glass	NI PL	= nickel plate				
GRD	= ground(ed)						

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A300	00618-6060	1	BOARD ASSY:-300 VPS	28480	00618-6060
C360	0150-0012	6	C:FXD CER 0.01 UF 20% 1000VDCW	56289	29C214A3
C361	0150-0012		C:FXD CER 0.01 UF 20% 1000VDCW	56289	29C214A3
C366	0150-0052	6	C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
CR301	1901-0029	3	DIODE:SILICON 600 PIV	28480	1901-0029
CR302	1901-0029		DIODE:SILICON 600 PIV	28480	1901-0029
DS301	2140-0047	3	LAMP:NEON GLOW 0.8MA	24455	A1C
F301	2110-0008	2	FUSE:0.50AMP 125V SLOW-BLOW	71400	MDL 1/2
	1400-0008	3	FUSEHOLDER:BRONZE CLIP	95915	3510-11
R360	0813-0040	1	R:FXD WW 20 OHM 5% 5W	28480	0813-0040
R361	0757-0789	5	R:FXD MET FLM 475K OHM 1% 1/4W	28480	0757-0789
R362	0757-0789		R:FXD MET FLM 475K OHM 1% 1/4W	28480	0757-0789
R363	0690-3911	2	R:FXD COMP 390 OHM 10% 1W	01121	GB 3911
R364	0757-0740	2	R:FXD MET FLM 2.21K OHM 1% 1/4W	28480	0757-0740
R365	0690-3911		R:FXD COMP 390 OHM 10% 1W	01121	GB 3911
R366	0757-0740		R:FXD MET FLM 2.21K OHM 1% 1/4W	28480	0757-0740
R367	0757-0789		R:FXD MET FLM 475K OHM 1% 1/4W	28480	0757-0789
R368	0757-0352	2	R:FXD MET FLM 150K OHM 1% 1/2W	28480	0757-0352
R369	0757-0131	2	R:FXD MET FLM 274K OHM 1% 1W	28480	0757-0131
R370	0757-0131		R:FXD MET FLM 274K OHM 1% 1W	28480	0757-0131
R371	0757-0871	2	R:FXD MET FLM 1.21 MEGOHM 1% 1/2W	28480	0757-0871
R372	0811-0007	1	R:FXD WW 10K OHM 1% 5W	28480	0811-0007
R373	0757-0156	4	R:FXD MET FLM 1.5 MEGOHM 1% 1/2W	28480	0757-0156
R374	0757-0872	2	R:FXD MET FLM 1.30 MEGOHM 1% 1/2W	28480	0757-0872
R375	0690-8241	1	R:FXD COMP 820K OHM 10% 1W	01121	GB 8241
R377	0757-0777	3	R:FXD MET FLM 121K OHM 1% 1/4W	28480	0757-0777
R379	0812-0038	1	R:FXD WW 8.66K OHM 3% 5W	28480	0812-0038
V301	1921-0014	2	ELECTRON TUBE: 7233 TRIODE LOW-MU	33173	7233
V302	1921-0014		ELECTRON TUBE: 7233 TRIODE LOW-MU	33173	7233
V303	1932-0030	2	ELECTRON TUBE:12AX7	02735	12AX7
V304	1932-0030		ELECTRON TUBE:12AX7	02735	12AX7
V305	1940-0007	1	ELECTRON TUBE:OB2	02735	OB2
A400	00618-6061	1	BOARD ASSY:-1000 VPS	28480	00618-6061
C401	0150-0012		C:FXD CER 0.01 UF 20% 1000VDCW	56289	29C214A3
C402	0150-0012		C:FXD CER 0.01 UF 20% 1000VDCW	56289	29C214A3
C405	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
C406	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
CR401	1901-0487	2	DIODE:SILICON 1500 PIV	28480	1901-0487
CR402	1901-0487		DIODE:SILICON 1500 PIV	28480	1901-0487
DS401	2140-0047		LAMP:NEON GLOW 0.8MA	24455	A1C
F401	2110-0008		FUSE:0.50AMP 125V SLOW-BLOW	71400	MDL 1/2
	1400-0008		FUSEHOLDER:BRONZE CLIP	95915	3510-11
R401	0693-3901	1	R:FXD COMP 39 OHM 10% 2W	01121	HB 3901
R404	0757-0862	3	R:FXD MET FLM 221K OHM 1% 1/2W	28480	0757-0862
R405	0757-0772	2	R:FXD MET FLM 68.1K OHM 1% 1/4W	28480	0757-0772
R406	0757-0156		R:FXD MET FLM 1.5 MEGOHM 1% 1/2W	28480	0757-0156
R407	0757-0854	2	R:FXD MET FLM 56.2K OHM 1% 1/2W	28480	0757-0854
R408	0693-2241	1	R:FXD COMP 220K OHM 10% 2W	01121	HB 2241
R409	0757-0156		R:FXD MET FLM 1.5 MEGOHM 1% 1/2W	28480	0757-0156
R410	0757-0789		R:FXD MET FLM 475K OHM 1% 1/4W	28480	0757-0789
R411	0757-0859	1	R:FXD MET FLM 110K OHM 1% 1/2W	28480	0757-0859
R412	2100-1472	2	R:VAR COMP 25K OHM 30% LIN 1/8W	28480	2100-1472
R413	0757-0870	2	R:FXD MET FLM 825K OHM 1% 1/2W	28480	0757-0870
R414	0757-0777		R:FXD MET FLM 121K OHM 1% 1/4W	28480	0757-0777
R415	0757-1000	2	R:FXD MET FLM 51.1 OHM 1% 1/2W	28480	0757-1000
R416	0757-1000		R:FXD MET FLM 51.1 OHM 1% 1/2W	28480	0757-1000
R417	0757-0283	2	R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
R418	0757-0283		R:FXD MET FLM 2.00K OHM 1% 1/8W	28480	0757-0283
R419	0757-0862		R:FXD MET FLM 221K OHM 1% 1/2W	28480	0757-0862
V401	1923-0071	3	ELECTRON TUBE:12HG7	02735	12HG7
V402	1940-0001	2	ELECTRON TUBE:5651	86684	5651A
V403	1923-0046	2	ELECTRON TUBE: 6EJ7 (EF 184) PENTODE	73445	5EJ7(EF184)
V404	1921-0005	2	ELECTRON TUBE: 6C4 TRIODE	33173	6C4
V405	1923-0071		ELECTRON TUBE:12HG7	02735	12HG7
A500	00618-6062	1	BOARD ASSY:-1550 VPS	28480	00618-6062
C501	0150-0012		C:FXD CER 0.01 UF 20% 1000VDCW	56289	29C214A3
C502	0150-0012		C:FXD CER 0.01 UF 20% 1000VDCW	56289	29C214A3
C505	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
C506	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
C507	0150-0052		C:FXD CER 0.05 UF 20% 400VDCW	56289	33C17A
CR501	1901-0036	2	DIODE:SILICON 1000 PIV	28480	1901-0036
CR502	1901-0036		DIODE:SILICON 1000 PIV	28480	1901-0036
DS501	2140-0047		LAMP:NEON GLOW 0.8MA	24455	A1C
F501	2110-0012	1	FUSE:CARTRIDGE 0.5A	28480	2110-0012

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont.)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
	1400-0008		FUSEHOLDER:BRONZE CLIP	95915	3510-11
R501	0693-4701	1	R:FXD COMP 47 OHM 10% 2W	01121	HB 4701
R502	0757-0374	2	R:FXD MET FLM 485K OHM 1% 1/2W	28480	0757-0374
R503	0757-0374		R:FXD MET FLM 485K OHM 1% 1/2W	28480	0757-0374
R504	0757-0313	2	R:FXD MET FLM 392K OHM 1% 1/2W	28480	0757-0313
R505	0757-0772		R:FXD MET FLM 68.1K OHM 1% 1/4W	28480	0757-0772
R506	0757-0156		R:FXD MET FLM 1.5 MEGOHM 1% 1/2W	28480	0757-0156
R507	0757-0854		R:FXD MET FLM 56.2K OHM 1% 1/2W	28480	0757-0854
R508	0730-0101	1	R:FXD DEPC 820K OHM 1% 1W	28480	0730-0101
R509	0757-0872		R:FXD MET FLM 1.30 MEGOHM 1% 1/2W	28480	0757-0872
R510	0757-0789		R:FXD MET FLM 475K OHM 1% 1/4W	28480	0757-0789
R511	0757-0777		R:FXD MET FLM 121K OHM 1% 1/4W	28480	0757-0777
R512	2100-1472		R:VAR COMP 25K OHM 30% LIN 1/8W	28480	2100-1472
R513	0757-0792	1	R:FXD MET FLM 681K OHM 1% 1/4W	28480	0757-0792
R514	0777-0002	2	R:FXD MET FLM 75K OHM 10% 7W	28480	0777-0002
R515	0771-0007	1	R:FXD MET FLM 30K OHM 10% 4W	28480	0771-0007
R518	0757-0367	1	R:FXD MET FLM 100K OHM 1% 1/2W	28480	0757-0367
R519	0757-0871		R:FXD MET FLM 1.21 MEGOHM 1% 1/2W	28480	0757-0871
R528	0698-6303	1	R:FXD MET OX 47K OHM 10% 7W	28480	0698-6303
V501	1923-0071		ELECTRON TUBE:12HG7	02735	12HG7
V502	1940-0001		ELECTRON TUBE:5651	86684	5651A
V503	1923-0046		ELECTRON TUBE: 6EJ7 (EF 184) PENTODE	73445	6EJ7(EF184)
V504	1921-0005		ELECTRON TUBE: 6C4 TRIODE	33173	6C4
A600	00618-632	1	BOARD ASSY:POWER MONITOR AMPLIFIER	28480	00618-632
CR601	1902-0041	1	DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
CR602	1901-0025	1	DIODE:SILICON 100MA/1V	07263	FD 2387
Q601	1854-0221	2	TSTR:SI NPN(REPL.BY 2N4044)	28480	1854-0221
Q602	1854-0221		TSTR:SI NPN(REPL.BY 2N4044)	28480	1854-0221
Q603	1854-0003	1	TSTR:SI NPN(SELECTED FROM 2N1711)	28480	1854-0003
R603	0757-0427	1	R:FXD MET FLM 1.5K 1% 1/8W	14674	C4
R604	0757-0437	2	R:FXD MET FLM 4750 OHM 1% 1/8W	28480	0757-0437
R605	0757-0437		R:FXD MET FLM 4750 OHM 1% 1/8W	28480	0757-0437
R606	0757-0439	1	R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439
R607	0757-0451	1	R:FXD MET FLM 24.3K OHM 1% 1/8W	28480	0757-0451
R608	0757-0352		R:FXD MET FLM 150K OHM 1% 1/2W	28480	0757-0352
R609	0757-0449	1	R:FXD FLM 20K OHM 1% 1/8W	28480	0757-0449
R610	0757-0862		R:FXD MET FLM 221K OHM 1% 1/2W	28480	0757-0862
R611	0757-0861	1	R:FXD MET FLM 130K OHM 1% 1/2W	28480	0757-0861
R612	2100-0898	1	R:VAR WW 500 OHM 5% LIN 1W	28480	2100-0898
A700	00618-6076	1	BOARD ASSY:KLYSTRON MODULATOR(618C)	28480	00618-6076
A700	00620-6030	1	BOARD ASSY:KLYSTRON MODULATOR(620B)	28480	00620-6030
C701	0160-0265	2	C:FXD CER 0.01 UF 20% 3000 V	56289	41C121A2
CR701	1902-0241	1	DIODE BREAKDOWN:100V	28480	1902-0241
CR702	1901-0026	3	DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
CR703	1901-0059	1	DIODE:SILICON 1N629	03877	1N629
R701	0757-0139	3	R:FXD MET FLM 1.1 MEGOHM 2% 1/2W	28480	0757-0139
R702	0757-0863	1	R:FXD MET FLM 243K OHM 1% 1/2W	28480	0757-0863
R703	0771-0005	1	R:FXD MET FLM 24K OHM 10% 4W	28480	0771-0005
R705	0777-0002		R:FXD MET FLM 75K OHM 10% 7W	28480	0777-0002
R706	2100-2154	2	R:VAR COMP 10K OHM 30% LIN 1/4W	28480	2100-2154
R707	2100-2154		R:VAR COMP 10K OHM 30% LIN 1/4W (FOR 618C ONLY)	28480	2100-2154
R708	0757-0133	2	R:FXD MET FLM 383K OHM 2% 1/2W	28480	0757-0133
V701	1921-0041	1	ELECTRON TUBE:7895	02735	7895
	1200-0086	1	SOCKET:NUVISTOR 5-PIN	71785	133-65-11-026
A800	00618-6075	1	BOARD ASSY:INTERCONNECTION	28480	00618-6075
CR801	1901-0026		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
CR802	1901-0026		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
R801	2100-0308	1	R:VAR WW 20HM 10% LIN 5W	28480	2100-0308
A900	00618-6077	2	BOARD ASSY:MODULATOR	28480	00618-6077
C115	0160-2120	8	C:FXD MICA 0.01UF 1%	04062	RDM30F103F3C
C122	0160-2306	3	C:FXD MICA 27 PF 5%	28480	0160-2306
C127	0140-0206	5	C:FXD MICA 270 PF 5%	72136	RDM15F271J 500V
C128	0160-2306		C:FXD MICA 27 PF 5%	28480	0160-2306
C129	0140-0206		C:FXD MICA 270 PF 5% FACTORY SELECTED PART	72136	RDM15F271J 500V
C130	0140-0162	1	C:FXD MICA 4700 PF 10%	28480	0140-0162
C131	0160-2120		C:FXD MICA 0.01UF 1%	04062	RDM30F103F3C
C132	0140-0206		C:FXD MICA 270 PF 5%	72136	RDM15F271J 500V
C138	0160-2204	4	C:FXD MICA 100PF 5%	72136	RDM15F101J3C
C139	0140-0206		C:FXD MICA 270 PF 5%	72136	RDM15F271J 500V
C140	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
CR101	1901-0029		DIODE:SILICON 600 PIV	28480	1901-0029

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont.)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
CR102	1901-0096	1	DIODE:SILICON 120V	01295	UG-888
L101	6188-60A	1	COIL:RF .350 MH	28480	6188-60A
R134	0690-3921	1	R:FXD COMP 3900 OHM 10% 1W FACTORY SELECTED PART	01121	GB 3921
R144	0690-1221	5	R:FXD COMP 1200 OHM 10% 1W	01121	GB 1221
R145	0693-1031	5	R:FXD COMP 10K OHM 10% 2W	01121	HB 1031
R148	0690-1541	3	R:FXD COMP 150K OHM 10% 1W	01121	GB 1541
R149	0690-2741	2	R:FXD COMP 270K OHM 10% 1W	01121	GB 2741
R150	0690-5641	1	R:FXD COMP 560K OHM +10% 1W	01121	GB 5641
R151	0690-2221	3	R:FXD COMP 2200 OHM 10% 1W	01121	GB 2221
R152	0690-2221		R:FXD COMP 2200 OHM 10% 1W	01121	GB 2221
R153	0690-4741	5	R:FXD COMP 470K OHM 10% 1W	01121	GB 4741
R154	0690-4741		R:FXD COMP 470K OHM 10% 1W	01121	GB 4741
R154			FACTORY SELECTED PART		
R155	0690-4731	8	R:FXD COMP 47K OHM 10% 1W	01121	GB 4731
R157	0690-2221		R:FXD COMP 2200 OHM 10% 1W	01121	GB 2221
R160	0693-3331	4	R:FXD COMP 33K OHM 10% 2W	01121	HB 3331
R161	0693-3331		R:FXD COMP 33K OHM 10% 2W	01121	HB 3331
R162	0690-1051	2	R:FXD COMP 1 MEGOHM 10% 1W	01121	GB 1051
R186	0690-4731		R:FXD COMP 47K OHM 10% 1W FACTORY SELECTED PART	01121	GB 4731
R187	0690-4731		R:FXD COMP 47K OHM 10% 1W	01121	GB 4731
R188	0690-1041	5	R:FXD COMP 100K OHM 10% 1W FACTORY SELECTED PART	01121	GB 1041
R189	0690-4741		R:FXD COMP 470K OHM 10% 1W	01121	GB 4741
R190	0690-1541		R:FXD COMP 150K OHM 10% 1W	01121	GB 1541
R191	0690-1841	1	R:FXD COMP 180K OHM 10% 1W	01121	GB 1841
R192	0690-4731		R:FXD COMP 47K OHM 10% 1W	01121	GB 4731
R193	0690-4721	2	R:FXD COMP 4700 OHM 10% 1W	01121	GB 4721
R194	0690-4731		R:FXD COMP 47K OHM 10% 1W	01121	GB 4731
R195	0690-6821	1	R:FXD COMP 6800 OHM 10% 1W	01121	GB 6821
R196	0693-3331		R:FXD COMP 33K OHM 10% 2W	01121	HB 3331
R197	0690-1251	7	R:FXD COMP 1.2 MEGOHM 10% 1W	01121	GB 1251
R198	0690-1031	4	R:FXD COMP 10K OHM 10% 1W	01121	GB 1031
R207	0690-5621	1	R:FXD COMP 5600 OHM 10% 1W	01121	GB 5621
R208	0690-8231	1	R:FXD COMP 82K OHM 10% 1W	01121	GB 8231
R326	0757-0309	1	R:FXD MET FLM 61.9K OHM 1% 1/2W	28480	0757-0309
R327	0757-0307	1	R:FXD MET FLM 332K OHM 1% 1/2W	28480	0757-0307
R328	0757-0313		R:FXD MET FLM 392K OHM 1% 1/2W	28480	0757-0313
A1000	00618-6078	2	BOARD ASSY:MODULATOR	28480	00618-6078
C102	0160-2120		C:FXD MICA 0.01UF 1%	04062	RDM30F103F3C
C103	0140-0149	4	C:FXD MICA 470 PF 5% FACTORY SELECTED PART	72136	DM15F471J3S
C104	0140-0197	1	C:FXD MICA 180 PF 5% 300 VDCW	04062	RDM15F181J3C
			FACTORY SELECTED PART		
C105	0160-2218	3	C:FXD MICA 1000 PF 5%	28480	0160-2218
C106	0160-2120		C:FXD MICA 0.01UF 1%	04062	RDM30F103F3C
C107	0160-2218		C:FXD MICA 1000 PF 5%	28480	0160-2218
C108	0160-3493	1			
C109	0160-2218		C:FXD MICA 1000 PF 5%	28480	0160-2218
C110	0160-2120		C:FXD MICA 0.01UF 1%	04062	RDM30F103F3C
C111	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
C112	0140-0190	1	C:FXD MICA 39 PF 5%	72136	RDM15E390J3C
C113	0140-0209	1	C:FXD MICA 5.0 PF 10%	28480	0140-0209
C114	0140-0191	1	C:FXD MICA 56 PF 5% 300VDCW	19701	RDM15E560J 300V
C116	0160-2306		C:FXD MICA 27 PF 5%	28480	0160-2306
C117	0160-2204		C:FXD MICA 100PF 5%	72136	RDM15F101J3C
C119	0140-0206		C:FXD MICA 270 PF 5%	72136	RDM15F271S 500V
C120	0150-0071	1	C:FXD CER 400 PF 5% 1000 VDCW	56289	C016B102E401J-CDH
C121	0160-2120		C:FXD MICA 0.01UF 1%	04062	RDM30F103F3C
C124	0160-2120		C:FXD MICA 0.01UF 1%	04062	RDM30F103F3C
C125	0160-2120		C:FXD MICA 0.01UF 1%	04062	RDM30F103F3C
C126	0140-0157	1	C:FXD MICA 1857 PF 1%	28480	0140-0157
C142	0160-0088	2	C:FXD PAPER 0.25UF 10% 1500VDCW	24446	47F1464
R101	0690-1251		R:FXD COMP 1.2 MEGOHM 10% 1W	01121	GB 1251
R102	0690-1251		R:FXD COMP 1.2 MEGOHM 10% 1W	01121	GB 1251
R103	0693-4731	1	R:FXD COMP 47K OHM 10% 2W	01121	HB 4731
R104	0690-1251		R:FXD COMP 1.2 MEGOHM 10% 1W	01121	GB 1251
R105	0690-4731		R:FXD COMP 47K OHM 10% 1W	01121	GB 4731
R106	0690-1041		R:FXD COMP 100K OHM 10% 1W	01121	GB 1041
R107	0693-2731	2	R:FXD COMP 27K OHM 10% 2W	01121	HB 2731
R108	0690-4741		R:FXD COMP 470K OHM 10% 1W	01121	GB 4741
R109	0690-1041		R:FXD COMP 100K OHM 10% 1W	01121	GB 1041
R110	0690-4731		R:FXD COMP 47K OHM 10% 1W	01121	GB 4731

Table 6-2. Replaceable Parts (Cont.)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
R115	0690-1051		R:FXD COMP 1 MEGOHM 10% 1W	01121	GB 1051
R116	0690-6811	1	R:FXD COMP 680 OHM 10% 1W	01121	GB 6811
R118	0693-1831	1	R:FXD COMP 18K OHM 10% 2W	01121	HB 1831
R119	0693-1031		R:FXD COMP 10K OHM 10% 2W	01121	HB 1031
R120	0690-4721		R:FXD COMP 4700 OHM 10% 1W	01121	GB 4721
R121	0690-2721	1	R:FXD COMP 2700 OHM 5% 1/4W	01121	GB 2721
R122	0693-2731		R:FXD COMP 27K OHM 10% 2W	01121	HB 2731
R123	0690-4731		R:FXD COMP 47K OHM 10% 1W	01121	GB 4731
R124	0690-1221		R:FXD COMP 1200 OHM 10% 1W	01121	GB 1221
R125	0690-4741		R:FXD COMP 470K OHM 10% 1W	01121	GB 4741
R126	0690-1031		R:FXD COMP 10K OHM 10% 1W	01121	GB 1031
R127	0690-1031		R:FXD COMP 10K OHM 10% 1W	01121	GB 1031
R128	0690-1251		R:FXD COMP 1.2 MEGOHM 10% 1W	01121	GB 1251
R129	0690-1031		R:FXD COMP 10K OHM 10% 1W	01121	GB 1031
R130	0690-1221		R:FXD COMP 1200 OHM 10% 1W	01121	GB 1221
R131	0690-2741		R:FXD COMP 270K OHM 10% 1W	01121	GB 2741
R132	0690-1251		R:FXD COMP 1.2 MEGOHM 10% 1W	01121	GB 1251
R135	0693-3331		R:FXD COMP 33K OHM 10% 2W	01121	HB 3331
R137	0690-2711	1	R:FXD COMP 270 OHM 10% 1W	01121	GB 2711
R138	0693-1031		R:FXD COMP 10K OHM 10% 2W	01121	HB 1031
R139	0693-1031		R:FXD COMP 10K OHM 10% 2W	01121	HB 1031
R140	0693-1031		R:FXD COMP 10K OHM 10% 2W	01121	HB 1031
R141	0690-1041		R:FXD COMP 100K OHM 10% 1W	01121	GB 1041
R142	0690-1541		R:FXD COMP 150K OHM 10% 1W	01121	GB 1541
R143	0690-1251		R:FXD COMP 1.2 MEGOHM 10% 1W	01121	GB 1251
R146	0690-1241	1	R:FXD COMP 120K OHM 10% 1W	01121	GB 1241
R159	0690-1011	1	R:FXD COMP 100 OHM 10% 1W	01121	GB 1011
R199	0690-1221		R:FXD COMP 1200 OHM 10% 1W	01121	GB 1221
			CHASSIS PARTS		
B1	3140-0052	1	MOTOR:SHADED POLE	28480	3140-0052
C101	0160-0081	3	C:FXD PAPER 0.25UF 10% 1000VDCW	14655	CP5581EG254K
C118	0160-0090	1	C:FXD PAPER 0.1UF 10% 1000VDCW	28480	0160-0090
C123	0160-0081		C:FXD PAPER 0.25UF 10% 1000VDCW	14655	CP5581EG254K
C135	0160-0087	1	C:FXD PAPER 0.5UF 10% 600VDCW	00656	P70MT
C136	0160-0088		C:FXD PAPER 0.25UF 10% 1500VDCW	24446	47F1454
C137	0160-0089	1	C:FXD PAPER 2(0.1UF)-10%+20%1000VDCW	00853	CP5484EG104V
C141	0160-0081		C:FXD PAPER 0.25UF 10% 1000VDCW	14655	CP5581EG254K
C143	0170-0038	1	C:FXD MY 0.22 UF 10% 200VDCW	56289	148P22492 PUM
C144	0180-0049	1	C:FXD ELECT 20 UF +75-10% 50VDCW	56289	30D206G050CC2-DSM
C362	0180-0024	5	C:FXD ELECT 40UF 450VDCW	56289	D32441
C363	0180-0024		C:FXD ELECT 40UF 450VDCW	56289	D32441
C365	0180-0024		C:FXD ELECT 40UF 450VDCW	56289	D32441
C403	0180-0042	4	C:FXD ELECT 120UF 350VDCW	56289	D32353
C404	0180-0042		C:FXD ELECT 120UF 350VDCW	56289	D32353
C407	0160-0102	3	C:FXD PAPER 4UF 10% 1000VDCW	02777	08D
C408	0180-0042		C:FXD ELECT 120UF 350VDCW	56289	D32353
C409	0180-0042		C:FXD ELECT 120UF 350VDCW	56289	D32353
C503	0180-0024		C:FXD ELECT 40UF 450VDCW	56289	D32441
C504	0180-0024		C:FXD ELECT 40UF 450VDCW	56289	D32441
C508,C509	0160-0102		C:FXD PAPER 4UF 10% 1000VDCW	02777	08D
C601	0180-0128	1	C:FXD ELECT 2800 UF +50-10% 30VDCW	56289	D35718 DFP
C702	0160-0265		C:FXD CER 0.01 UF 20% 3000 VDCW	56289	41C123A2
CR103	1901-0030	1	DIODE:SI 800 PIV	28480	1901-0030
CR603	00618-628	2	DETECTOR ASSY:BOLOMETER	28480	00618-628
DS40	2140-0244	1	LAMP:GLOW MINIATURE 95V	87034	A1H
F101	2110-0029	1	FUSE:CARTRIDGE 3 AMP 125V SLOW BLOW(115V)	75915	313003
	1400-0084	1	FUSEHOLDER:EXTRACTOR POST TYPE	75915	342014
F101	2110-0059	1	FUSE:CARTRIDGE 1-1/2A SLO-BLO(230V)	71400	MDL 1.5
FL301	9110-0014	1	LINE:FILTER 2X3 AMP 115V-230V	56289	SK 22574
J101	6188-16T	1	CABLE:SYNC IN	28480	6188-16T
J102	6188-16U	1	CABLE:SYNC OUT	28480	6188-16U
J103	6188-16S	1	CABLE:EXT MOD	28480	6188-16S
J104	6188-16V	1	CABLE:DELAYED SYNC OUT	28480	6188-16V
J105	1250-0144	2	CONNECTOR:RECEPTACLE JACK CO-AXIAL TYPE	28480	1250-0144
J106	1250-0144		CONNECTOR:RECEPTACLE JACK CO-AXIAL TYPE	28480	1250-0144
J301	1251-0148	1	CONNECTOR:POWER 3 PIN MALE	87930	1065-1
J303	1251-1036	2	CONNECTOR:7 CONTACT MINIATURE HEX	81312	M7S
L102	9170-0029	1	CORE:FERRITE BEAD	02114	56-590-65A2/4A
M101	1120-1277	1	METER:0-181 MA	28480	1120-1277
P302	1251-0194	2	CONNECTOR:PRINTED CIRCUIT 15-CONTACT	28480	1251-0194
R111	2100-0059	1	R:VAR COMP 3X1 MEGOHM 10% LIN 2W	28480	2100-0059
R112	2100-0029	2	R:VAR COMP 250K OHM 10% LIN 2W	28480	2100-0029
R113	2100-0029		R:VAR COMP 250K OHM 10% LIN 2W	28480	2100-0029
R114			N.S.R. PART OF R111		
R117	2100-0025	3	R:VAR COMP 1500 OHM 10% LIN 2W	28480	2100-0025

Table 6-2. Replaceable Parts (Cont.)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
R133	2100-0025		R:VAR COMP 1500 OHM 10% LIN 2W	28480	2100-0025
R136	2100-0047	2	R:VAR COMP 1 MEGOHM 20% 1.12W	28480	2100-0047
R147			N.S.R. PART OF R111 AND R114		
R156	2100-0025		R:VAR COMP 1500 OHM 10% LIN 2W	28480	2100-0025
R158	2100-0051	1	R:VAR COMP 20K OHM 10% CWLOG 2W	28480	2100-0051
R168	2100-0047		R:VAR COMP 1 MEGOHM 20% 1.12W	28480	2100-0047
R169	0690-1041		R:FXD COMP 100K OHM 10% 1W	01121	GB 1041
R170	2100-0028	4	R:VAR COMP 50K OHM 10% LIN 2W	28480	2100-0028
R171	0693-1531	1	R:FXD COMP 15K OHM 10% 2W	01121	HB 1531
R172	0693-8231	1	R:FXD COMP 82K OHM 10% 2W	01121	HB 8231
R173	2100-0028		R:VAR COMP 50K OHM 10% LIN 2W	28480	2100-0028
R174	2100-0127	1	R:VAR 100K OHM 10% 8W	28480	2100-0127
R175	2100-0028		R:VAR COMP 50K OHM 10% LIN 2W	28480	2100-0028
R176	0693-4721	2	R:FXD COMP 4700 OHM 10% 2W	01121	HB 4721
R177	0693-4721		R:FXD COMP 4700 OHM 10% 2W	01121	HB 4721
R178	2100-0028		R:VAR COMP 50K OHM 10% LIN 2W	28480	2100-0028
R204	0687-1011	1	R:FXD COMP 100 OHM 10% 1/2W	01121	EB 1011
R205	0690-1221		R:FXD COMP 1200 OHM 10% 1W	01121	GB 1221
R209	0757-0815	1	R:FXD MET FLM 562 OHM 1% 1/2W	28480	0757-0815
R376	0757-0123	1	R:FXD MET FLM 34.8K OHM 1% 1/8W	91637	MF-1/10-32
R421	0687-4741	4	R:FXD COMP 470K OHM 10% 1/2W	01121	EB 4741
R422	0687-4741		R:FXD COMP 470K OHM 10% 1/2W	01121	EB 4741
R423	0687-4741		R:FXD COMP 470K OHM 10% 1/2W	01121	EB 4741
R424	0687-4741		R:FXD COMP 470K OHM 10% 1/2W	01121	EB 4741
R516	0761-0099	2	R:FXD MET FLM 430K OHM 5% 1W	28480	0761-0099
R517	0761-0099		R:FXD MET FLM 430K OHM 5% 1W	28480	0761-0099
R520	0757-0870		R:FXD MET FLM 825K OHM 1% 1/2W	28480	0757-0870
R521	0757-0139		R:FXD MET FLM 1.1 MEGOHM 2% 1/2W	28480	0757-0139
R522	0757-0139		R:FXD MET FLM 1.1 MEGOHM 2% 1/2W	28480	0757-0139
R523	2100-0465	1	R:VAR COMP 1 MEGOHM 20% LIN 2-1/4W	28480	2100-0465
R524	0757-0133		R:FXD MET FLM 383K OHM 2% 1/2W	28480	0757-0133
R525	0757-0059	2	R:FXD MET FLM 1 MEGOHM 1% 1/2W	28480	0757-0059
R526	0757-0059		R:FXD MET FLM 1 MEGOHM 1% 1/2W	28480	0757-0059
R527	0698-3260	1	R:FXD MET FLM 464K OHM 1% 1/8W	91637	CMF-1/10-32
R527			FACTORY SELECTED PART		
RT101	0839-0006	1	THERMISTOR: 10 OHM 10% AT 25C	24446	2D-754
S1	3101-1248	1	SWITCH:PUSHBUTTON SPDT ILLUMINATED	87034	53-55480-121/A1H
S101	6188-198	1	SWITCH ASSY:MOD	28480	6188-198
S102	00618-625	1	SWITCH ASSY:MOD	28480	00618-625
S103	3102-0001	1	SWITCH: SENSITIVE SPDT	91929	BZ 285
S306	3101-0033	1	SWITCH:SLIDE DPDT 0.5A 125AC/DC	82389	11A-1009A
T1	9100-1703	1	TRANSFORMER:POWER	28480	9100-1703
TB1	0360-0064	1	BOARD:TERMINAL	71785	356-17-11-001
V101	1932-0045	1	ELECTRON TUBE:12AT7	13396	12AT7
	1200-0003	8	SOCKET:TUBE	71785	121-31-12-104
	1220-0007	1	SHIELD:TUBE	71785	151-11-33-013(101)
V102	1930-0013	3	ELECTRON TUBE: 6AL5 TWIN DIODE	33173	6AL5
	1200-0017	4	SOCKET:TUBE 7 CONTACT MINIATURE	71785	111-39-11-014
V103	1932-0046	7	ELECTRON TUBE:12AU7	13396	12AU7
	1220-0009	7	SHIELD-TUBE	71785	151-11-23-012
	1200-0003		SOCKET:TUBE	71785	121-31-12-104
V104	1932-0046		ELECTRON TUBE:12AU7	13396	12AU7
	1200-0003		SOCKET:TUBE	71785	121-31-12-104
	1220-0009		SHIELD-TUBE	71785	151-11-23-012
V105	1932-0046		ELECTRON TUBE:12AU7	13396	12AU7
	1200-0003		SOCKET:TUBE	71785	121-31-12-104
	1220-0009		SHIELD-TUBE	71785	151-11-23-012
V106	1930-0013		ELECTRON TUBE: 6AL5 TWIN DIODE	33173	6AL5
	1200-0017		SOCKET:TUBE 7 CONTACT MINIATURE	71785	111-39-11-014
V107	1932-0046		ELECTRON TUBE:12AU7	13396	12AU7
	1200-0003		SOCKET:TUBE	71785	121-31-12-104
	1220-0009		SHIELD-TUBE	71785	151-11-23-012
V108	1930-0013		ELECTRON TUBE: 6AL5 TWIN DIODE	33173	6AL5
	1200-0017		SOCKET:TUBE 7 CONTACT MINIATURE	71785	111-39-11-014
V109	1932-0046		ELECTRON TUBE:12AU7	13396	12AU7
	1200-0003		SOCKET:TUBE	71785	121-31-12-104
	1220-0009		SHIELD-TUBE	71785	151-11-23-012
V110	1941-0005	1	ELECTRON TUBE: 2D21 TETRODE THY 7 PIN	86684	2D21
	1200-0017		SOCKET:TUBE 7 CONTACT MINIATURE	71785	111-39-11-014
V111	1932-0046		ELECTRON TUBE:12AU7	13396	12AU7
	1200-0003		SOCKET:TUBE	71785	121-31-12-104
	1220-0009		SHIELD-TUBE	71785	151-11-23-012
V114	1950-0017	1	ELECTRON TUBE: QKK860 KLYSTRON (FOR 620B ONLY)	28480	1950-0017
V114	6188-95G	1	ELECTRON TUBE(618C)	28480	6188-95G

Table 6-2. Replaceable Parts (Cont.)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
V114	1950-0004	1	ELECTRON TUBE: 6236 KLYSTRON (FOR 618C ONLY)	28480	1950-0004
V115	1932-0046		ELECTRON TUBE:12AU7	13396	12AU7
	1200-0003		SOCKET:TUBE	71785	121-31-12-104
	1220-0009		SHIELD-TUBE	71785	151-11-23-012
			620B MISCELLANEOUS ONLY		
	620A-34BB	1	ATTENUATOR ASSY	28480	620A-34BB
	00620-623	1	BOLOMETER ASSY	28480	00620-623
	00620-624	1	PROBE ASSY:SAMPLE	28480	00620-624
			618C MISCELLANEOUS ONLY		
	618B-27	1	FILTER:R.F.	28480	618B-27
	618B-34AA	1	ATTENUATOR ASSY	28480	618B-34AA
	618B-35	1	DRIVE ASSY:ATTENUATOR	28480	618B-35
	618B-36AK	1	FILTER:REPELLER ASSY	28480	618B-36AK
	618B-36AP	1	CAPACITOR ATTENUATOR HOUSING	28480	618B-36AP
	618B-36BC	1	PLUNGER ASSY	28480	618B-36BC
	618B-47C	1	SPACER:DIAL WINDOW	28480	618B-47C
	618B-40B	1	COVER:FREQ DIAL	28480	618B-40B
	00618-024	1	BRACKET:MODULATOR POTS	28480	00618-024
	00618-622	1	CONTROL ASSY:FREQ.	28480	00618-622
	00618-623	1	BOLOMETER ASSY	28480	00618-623
	00618-640	1	PROBE ASSY:SAMPLE	28480	00618-640
	00618-643	1	BOARD ASSY:TRACKING RESISTOR	28480	00618-643
			618C/620B MISCELLANEOUS		
	1251-0194		CONNECTOR:PRINTED CIRCUIT 15-CONTACT	28480	1251-0194
	1251-0234	1	CONNECTOR:PC 6 CONTACT	95354	SD-606 URB
	1251-1036		CONNECTOR:7 CONTACT MINIATURE HEX	81312	M7S
	1251-1037	1	CONNECTOR:MINAT MALE PLUG 7-CONTACT	81312	M7P
	618B-52B	1	COVER:SOCKET HOUSING	28480	618B-52B
	00618-628		DETECTOR ASSY:BOLOMETER	28480	00618-628
	618B-40P	1	DIAL:FREQUENCY VERNIER	28480	618B-40P
	618B-52	1	SOCKET ASSY	28480	618B-52
	618B-40H	1	DIAL ASSY:PULSE WIDTH	28480	618B-40H
	618B-40G	1	DIAL ASSY:PULSE RATE	28480	618B-40G
	618B-40F	1	DIAL ASSY:PULSE DELAY	28480	618B-40F
	618B-40C	1	DIAL:ATTENUATOR	28480	618B-40C
	618B-40E	1	DIAL:POWER SET	28480	618B-40E
	0340-0020	1	INSULATOR:STANDOFF 3/8" DIA	72656	1023-04-3/4"
	0370-0028	1	KNOB:ROUND BLACK 1" DIA	28480	0370-0028
	0370-0029	1	KNOB:BLACK W/ARROW 1" DIA 1/4" SHAFT	28480	0370-0029
	0370-0035	1	KNOB:SKIRTED BAR 1" DIA	28480	0370-0035
	0370-0038	1	KNOB:BLACK 1-5/8" DIA	28480	0370-0038
	0370-0050	1	HANDLE:CRANK ONLY 3/8" DD	28480	0370-0050
	00618-624	1	PULSER ASSY	28480	00618-624
	1200-0053	1	SOCKET:TUBE 7 PIN MINAT	71785	111-51-11-069
	1200-0058	1	SOCKET-TUBE 9-PIN	91662	3901PHSPTD
	1200-0062	1	SOCKET:TUBE 9 PIN MIN.	71785	121-51-11-069
	1200-0083	1	SOCKET:ELECTRON TUBE 7-PIN MINAT	91662	04-730-02
	5020-0234	1	HUB:DIAL	28480	5020-0234
	5020-0278	1	GEAR:OFFSET TOOTH	28480	5020-0278
	5040-0216	1	WINDOW:DIAL ATTENUATOR	28480	5040-0216
	6180-38	1	WRENCH:SOCKET	28480	6180-38
	00618-6077		BOARD ASSY:MODULATOR	28480	00618-6077
	00618-6078		BOARD ASSY:MODULATOR	28480	00618-6078
	00618-634	1	CABINET ASSY	28480	00618-634
	00618-635	1	RACK CABINET ASSY	28480	00618-635
	8120-1348	1	CABLE ASSY:POWER, DETACHABLE	70903	KHS-7041

See introduction to this section for ordering information

Table 6-3. Code List of Manufacturers

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

Code No.	Manufacturer	Address
00000	U. S. A Common	Any supplier of U.S.
00136	McCoy Electronics.	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N.Y.
00287	Cemco, Inc.	Danielson, Conn.
00334	Humidial	Colton, Calif.
00348	Mictron, Co., Inc.	Valley Stream, N.Y.
00373	Garlock Inc.	Cherry Hill, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp, Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00809	Croven, Ltd.	Whitby, Ontario, Canada
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Co., Pickens Div.	Pickens, S.C.
00866	Goe Engineering Co.	City of Industry, Cal.
00891	Carl E. Holmes Corp.	Los Angeles, Cal.
00929	Microlab Inc.	Livingston, N.J.
01002	General Electric Co., Capacitor Dept.	Hudson Falls, N.Y.
01009	Alden Products Co.	Brockton, Mass.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Cal.
01281	TRW Semiconductors, Inc.	Lawndale, Cal.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co	Alliance, Ohio
01538	Small Parts Inc.	Los Angeles, Cal.
01589	Pacific Relays, Inc.	Van Nuys, Cal.
01670	Gudebrod Bros. Silk Co.	New York, N.Y.
01930	Amerock Corp.	Rockford, Ill.
01960	Pulse Engineering Co	Santa Clara, Cal.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02116	Wheelock Signals, Inc.	Long Branch, N.J.
02286	Cole Rubber and Plastics Inc	Sunnyvale, Cal.
02660	Amphenol-Borg Electronics Corp.	Broadview, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Division	Somerville, N.J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins EngineeringCo.	San Fernando, Cal.
02875	Hudson Tool & Die	Newark, N.J.
03296	Nylon Molding Corp.	Springfield, N.J.
03508	G. E. Semiconductor Prod. Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	Compton, Calif.
03818	Parker Seal Co.	Los Angeles, Cal.
03877	Transitron Electric Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N.J.
03954	Singer Co., Diehl Div., Finderne Plant	Sumerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Taruus Corp.	Lambertville, N.J.
04062	Arco Electronic Inc.	Great Neck, N.Y.
04217	Essex Wire	Los Angeles, Cal.
04222	Hi-Q Division of Aerovox.	Myrtle Beach, S.C.
04354	Precision Paper Tube Co.	Wheeling, Ill.
04404	Palo Alto Division of Hewlett-Packard Co.	Palo Alto, Cal.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Cal.
04673	Dakota Engr. Inc.	Culver City, Cal.
04713	Motorola Inc. Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc. Western Div.	Culver City, Cal.
04773	Automatic Electric Co.	Northlake, Ill.
04796	Sequoia Wire Co.	Redwood City, Cal.
04811	Precision Coil Spring Co.	El Monte, Cal.
04870	P. M. Motor Company	Westchester, Ill.
04919	Component Mfg. Service Co.	W. Bridgewater, Mass.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Cal.
05277	Westinghouse Electric Corp. Semiconductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Cal.
05397	Union Carbine Corp., Elect. Div.	New York, N.Y.
05574	Viking Ind. Inc.	Canoga Park, Cal.
05593	Icore Electro-Plastics Inc.	Sunnyvale, Cal.
05616	Cosmo Plastic (c/o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Ill.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N.Y.
05729	Metro-Tel Corp.	Westbury, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Cal.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	Bassick Co., Div. of Stewart Warner Corp.	Bridgeport, Conn.
06090	Raychem Corp.	Redwood City, Cal.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.
06402	E. T. A. Products Co. of America	Chicago, Ill.
06540	Amatom Electronic Hardware Co., Inc.	New Rochelle, N.Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06666	General Devices Co., Inc.	Indianapolis, Ind.
06751	Components Inc., Ariz. Div.	Phoenix, Arizona
06812	Torrington Mfg. Co., West Div.	Van Nuys, Cal.
06980	Varian Assoc. Etmac Div.	San Carlos, Cal.
07088	Kelvin Electric Co.	Van Nuys, Cal.
07126	Digitran Co.	Pasadena, Cal.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp., Electronic Tube Div.	Elmira, N.Y.
07149	Filmohm Corp.	New York, N.Y.
07233	Cinch-Graphik Co.	City of Industry, Cal.
07256	Silicon Transistor Corp.	Carle Place, N.Y.
07261	Arnel Corp.	Culver City, Cal.
07263	Fairchild Camera & Inst. Corp., Semiconductor Div.	Mountain View, Cal.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	Birtcher Corp, The	Monterey Park, Cal.
07397	Sylvania Elect. Prod. Inc., Mt. View Operations	Mountain View, Cal.
07700	Technical Wire Products Inc.	Cranford, N.J.
07829	Bodine Elect. Co.	Chicago, Ill.
07910	Continental Device Corp.	Hawthorne, Cal.
07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Cal.
07980	Hewlett-Packard Co., New Jersey Division	Rockaway, N.J.
08145	U. S. Engineering Co.	Los Angeles, Cal.
08289	Blinn, Delbert Co.	Pomona, Cal.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp.	Los Angeles, Cal.
08664	Bristol Co., The	Waterbury, Conn.
08717	Sloan Company	Sun Valley, Cal.
08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona
08727	National Radio Lab. Inc.	Paramus, N.J.
08792	CBS Electronics Semiconductor Operations, Div. of CBS Inc	Lowell, Mass.
08806	General Electric Co., Miniature Lamp Dept.	Cleveland, Ohio
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays Div.	Costa Mesa, Cal.
09097	Electronic Enclosures Inc.	Los Angeles, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Tech. Ind. Inc. Atohm Elect.	Burbank, Cal.
09250	Electro Assemblies, Inc.	Chicago, Ill.
09353	C & K Components Inc.	Newton, Mass.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
09795	Pennsylvania Florocarbon.	Clifton Heights, Penn.
09922	Burndy Corp.	Norwalk, Conn.
10214	General Transistor Western Corp.	Los Angeles, Cal.
10411	Ti-Tal, Inc.	Berkeley, Cal.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Cal.
11242	Bay State Electronics Corp.	Waltham, Mass.
11312	Teledyne Inc., Microwave Div.	Palo Alto, Cal.
11314	National Seal	Downey, Cal.
11453	Precision Connector Corp.	Jamaica, N.Y.
11534	Duncan Electronics Inc.	Costa Mesa, Cal.
11711	General Instrument Corp., Semiconductor Division Products Group	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Cal.
11870	Melabs, Inc.	Palo Alto, Cal.
12136	Philadelphia Handle Co.	Camden, N.J.
12361	Grove Mfg. Co., Inc.	Shady Grove, Pa.
12574	Gulton Ind. Inc., Data System Div.	Albuquerque, N.M.
12697	Clarostat Mfg. Co.	Dover, N.H.
12728	Elmar Filter Corp	W. Haven, Conn.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12881	Metex Electronics Corp.	Clark, N.J.
12930	Delta Semiconductor Inc.	Newport Beach, Cal.
12954	Dickson Electronics Corp.	Scottsdale, Arizona
13019	Airco Supply Co., Inc.	Witchita, Kansas
13061	Wilco Products	Detroit, Mich.
13103	Thermolloy	Dallas, Texas
13327	Solitron Devices Inc.	Tappan, N.Y.
13396	Telefunken (GmbH)	Hanover, Germany
13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Cal.
14193	Calif. Resistor Corp	Santa Monica, Cal.
14298	American Components, Inc.	Conshohocken, Pa.
14433	ITT Semiconductor, a Div. of Int. Telephone and Telegraph Corporation	West Palm Beach, Fla.
14493	Hewlett-Packard Company.	Loveland, Colo.
14655	Cornell Dublier Electric Corp	Newark, N.J.
14674	Corning Glass Works	Corning, N.Y.
14752	Electro Cube Inc.	San Gabriel, Cal.
14960	Williams Mfg. Co.	San Jose, Cal.
15106	The Sphere Co., Inc.	Little Falls, N.J.
15203	Webster Electronics Co.	New York, N.Y.
15287	Scionics Corp.	Northridge, Cal.
15291	Adjustable Bushing Co.	N. Hollywood, Cal.
15558	Micron Electronics. Garden City, Long Island, N.Y.	
15566	Amprobe Inst. Corp.	Lynbrook, N.Y.
15631	Cabletronics	Costa Mesa, Cal.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Cal.
15801	Fenwal Elect. Inc.	Framingham, Mass.
15818	Amelco Inc.	Mountain View, Cal.
16037	Spruce Pine Mica Co.	Spruce Pine, N.C.
16179	Omni-Spectra Inc.	Detroit, Ill.
16352	Computer Diode Corp.	Lodi, N.J.
16554	Electroid Co.	Union, N.J.
16585	Boots Aircraft Nut Corp.	Pasadena, Cal.
16688	Ideal Prec. Meter Co., Inc., De Jur Meter Div.	Brooklyn, N.Y.
16758	Delco Radio Div. of G.M. Corp.	Kokomo, Ind.
17109	Thermonetics Inc.	Canoga Park, Cal.
17474	Tranex Company	Mountain View, Cal.
17675	Hamlin Metal Products Corp.	Akron, Ohio
17745	Angstrohm Prec. Inc.	No. Hollywood, Cal.
17856	Siliconix Inc.	Sunnyvale, Cal.
17870	McGraw-Edison Co.	Manchester, N.H.
18042	Power Design Pacific Inc.	Palo Alto, Cal.
18083	Clevite Corp. Semiconductor Div.	Palo Alto, Cal.
18324	Signetics Corp.	Sunnyvale, Cal.
18476	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
18486	TRW Elect. Comp. Div.	Des Plaines, Ill.
18565	Chomerics	Plainville, Mass.
18583	Curtis Instrument, Inc.	Mt. Kisco, N.Y.
18612	Vishay Instruments Inc.	Malvern, Pa.
18873	E. I. DuPont and Co., Inc.	Wilmington, Del.
18911	Durant Mfg. Co.	Milwaukee, Wis.
19315	The Bendix Corp., Navigation & Control Div.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison	West Orange, N.J.
19589	Concoa	Baldwin Park, Cal.

From: Handbook Supplements H4-1 Dated January 1970

Table 6-3. Code List of Manufacturers (Cont'd)

Code No.	Manufacturer	Address
19644	LRC Electronics	Horseheads, N.Y.
19701	Electra Mfg. Co.	Independence, Kansas
20183	General Atronics Corp.	Philadelphia, Pa.
21226	Executone, Inc.	Long Island City, N.Y.
21355	Fafnir Bearing Co., The	New Britian, Conn.
21520	Fansteel Metallurgical Corp.	N. Chicago, Ill.
23020	General Reed Co.	Metuchen, N.J.
23042	Texscan Corp.	Indianapolis, Ind.
23783	British Radio Electronics Ltd.	Washington, D.C.
24455	G.E. Lamp Division	Nela Park, Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
24681	Memcor Inc., Comp. Div.	Huntington, Ind.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobert File Co. of America, Inc.	Carlstadt, N.J.
26851	Compac Hollister Co.	Hollister, Cal.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co.	Palo Alto, Cal.
28520	Heyman Mfg. Co.	Kenilworth, N.J.
30817	Instrument Specialties Co., Inc.	Little Falls, N.J.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Stanwyck Coil Products, Ltd.	Hawkesbury, Ontario, Canada
36287	Cunningham, W.H. & Hill, Ltd.	Toronto, Ontario, Canada
37942	P.R. Mallory & Co., Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
40931	Honeywell Inc.	Minneapolis, Minn.
42190	Muter Co.	Chicago, Ill.
43990	C.A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
46384	Penn Eng. & Mfg. Corp.	Doylestown, Pa.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer & Inst. Co.	Southampton, Pa.
49956	Microwave & Power Tube Div.	Waltham, Mass.
52090	Rowan Controller Co.	Westminster, Md.
52983	HP Co., Med. Elec. Div.	Waltham, Mass.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & System Div.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
58474	Superior Elect. Co.	Bristol, Conn.
59446	Telex Corp.	Tulsa, Okla.
59730	Thomas & Betts Co.	Elizabeth, N.J.
60741	Triplett Electrical Inst. Co.	Bluffton, Ohio
61775	Union Switch and Signal Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Inc. Weston-Newark	Newark, N.J.
66295	Wittek Mfg. Co.	Chicago, Ill.
66346	Minnesota Mining & Mfg. Co. Revere Mincom Div.	St. Paul, Minn.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control	New York, N.Y.
70318	Allmetal Screw Product Co., Inc.	Garden City, N.Y.
70417	Amplex, Div. of Chrysler Corp.	Detroit, Mich.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	Union City, N.J.
70674	ADC Products Inc.	Minneapolis, Minn.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electric Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71034	Bliley Electric Co., Inc.	Erie, Pa.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincey, Mass.
71218	Bud Radio, Inc.	Willoughby, Ohio
71279	Cambridge Thermionics Corp.	Cambridge, Mass.
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Cardwell Condenser Corp.	Lindenhurst, L.I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	St. Louis, Mo.
71436	Chicago Condenser Corp.	Chicago, Ill.
71447	Calif. Spring Co., Inc.	Pico-Rivera, Cal.
71450	CTS Corp.	Elkhart, Ind.
71468	ITT Cannon Electric Inc.	Los Angeles, Cal.
71471	Cinema, Div. Aerovox Corp.	Burbank, Cal.
71482	C.P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Ill.
71700	Cornish Wire Co., The	New York, N.Y.
71707	Coto Coil Co., Inc.	Providence, R.I.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71785	Cinch Mfg. Co., Howard B. Jones Div.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.	Keasby, N.J.
72699	General Instrument Corp., Cap Division	Newark, N.J.
72765	Drake Mfg. Co.	Harwood Heights, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72962	Elastic Stop Nut Corp.	Union, N.J.
72964	Robert M. Hadley Co.	Los Angeles, Cal.
72982	Erie Technological Products, Inc.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73076	H.M. Harper Co.	Chicago, Ill.
73138	Helipot Div. of Beckman Inst., Inc.	Fullerton, Cal.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Cal.
73445	Amperex Elect. Co.	Hicksville, L.I., N.Y.
73506	Bradley Semiconductor Corp.	New Haven, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73586	Circle F Mfg. Co.	Trenton, N.J.
73682	George K. Garrett Co., Div. MSL Industries, Inc.	Philadelphia, Pa.
73734	Federal Screw Products, Inc.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	General Industries Co., The	Elyria, Ohio
73846	Goshen Stamping & Tool Co.	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.	San Jose, Cal.
73957	Groove-Pin Corp.	Ridgefield, N.J.
74276	Signalite Inc.	Neptune, N.J.
74455	J.H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Borg Electronic Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75263	Keystone Carbon Co., Inc.	St. Marys, Pa.
75378	CTS Knights, Inc.	Sandwich, Ill.
75382	Kulka Electric Corp.	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littlefuse, Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Cal.
76433	General Instrument Corp., Micamold Division	Newark, N.J.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Cal.
76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.	San Leandro, Cal.
76545	Mueller Electric Co.	Cleveland, Ohio
76703	National Union	Newark, N.J.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	The Bendix Corp., Electrodynamics Div.	N. Hollywood, Cal.
77075	Pacific Metals Co.	San Francisco, Cal.
77221	Phaostran Instrument and Electronic Co.	So. Pasadena, Cal.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.	Princeton, Ind.
77630	TRW Electronic Components Div.	Camden, N.J.
77638	General Instrument Corp., Rectifier Division	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Cal.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78277	Sigma	So. Braintree, Mass.
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn Inc.	Pitman, N.J.
78452	Thompson-Bremer & Co.	Chicago, Ill.
78471	Tilley Mfg. Co.	San Francisco, Cal.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	San Gabriel, Cal.
78947	Ucinite Co.	Newtonville, Mass.
79136	Waldes Kohinoor Inc.	Long Island City, N.Y.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80033	Prestole Corp.	Toledo, Ohio
80120	Schnitzer Alloy Products Co.	Elizabeth, N.J.
80131	Electronic Industries Association. Standard tube or semi-conductor device, any manufacturer.	
80207	Unimax Switch, Div. Maxon Electronics Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Inc.	Riverside, Cal.
80411	Arco Div. of Robertshaw Controls Co.	Columbus, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Label Co.	Monrovia, Cal.
80583	Hammarlund Co., Inc.	Mars Hill, N.C.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
80813	Dimco Gray Co.	Dayton, Ohio
81030	International Inst. Inc.	Orange, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Cal.
81312	Winchester Elec. Div. Litton Ind., Inc.	Oakville, Conn.
81349	Military Specification	
81483	International Rectifier Corp.	El Segundo, Cal.
81541	Airpax Electronics, Inc.	Cambridge, Maryland
81860	Barry Controls, Div. Barry Wright Corp.	Watertown, Mass.
82042	Carter Precision Electric Co.	Skokie, Ill.
82047	Sperti Faraday Inc., Copper Hewitt Electric Div.	Hoboken, N.J.
82116	Electric Regulator Corp.	Norwalk, Conn.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Fairchild Camera & Inst. Corp., Space & Defense Systems Div.	Paramus, N.J.
82209	Magurie Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod., Inc. Electronic Tube Division	Emporium, Pa.
82376	Astron Corp.	East Newark, Harrison, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals & Controls Inc., Spencer Products	Attleboro, Mass.
82768	Phillips-Advance Control Co.	Joliet, Ill.
82866	Research Products Corp.	Madison, Wis.
82877	Rolton Mfg. Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Cal.
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.	Darlington, S.C.
83148	ITT Wire and Cable Div.	Los Angeles, Cal.
83186	Victory Eng. Corp.	Springfield, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83315	Hubbell Corp.	Mundelein, Ill.
83324	Rosan Inc.	Newport Beach, Cal.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83332	Tech Labs	Palisades Park, N.J.
83385	Central Screw Co.	Chicago, Ill.
83501	Gavitt Wire and Cable Co., Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp., Electronic Tube Div.	Plainfield, N.J.
83740	Union Carbide Corp., Consumer Prod. Div.	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
83942	Aeronautical Inst. & Radio Co.	Lodi, N.J.
84171	Arco Electronics Inc.	Great Neck, N.Y.
84396	A.J. Glesener Co., Inc.	San Francisco, Cal.
84411	TRW Capacitor Div.	Ogallala, Neb.

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Table 6-3. Code List of Manufacturers (Cont'd)

Code No.	Manufacturer	Address
4970	Sarkes Tarzian, Inc.	Bloomington, Ind.
#5454	Boonton Molding Company	Boonton, N.J.
#5471	A. B. Boyd Co.	San Francisco, Cal.
#5474	R. M. Bracamonte & Co.	San Francisco, Cal.
#5660	Koiled Kords, Inc.	Hamden, Conn.
#5911	Seamless Rubber Co.	Chicago, Ill.
#6174	Fafnir Bearing Co.	Los Angeles, Calif.
#6197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.
5579	Precision Rubber Products Corp.	Dayton, Ohio
#6684	Radio Corp. of America, Electronic Comp. & Devices Division	Harrison, N.J.
5928	Seastrom Mfg. Co.	Glendale, Cal.
7034	Marco Industries	Anaheim, Cal.
7216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
7473	Western Fibrous Glass Products Co.	San Francisco, Cal.
7664	Van Waters & Rogers Inc.	San Francisco, Cal.
7930	Tower Mfg. Corp.	Providence, R.I.
8140	Cutler-Hammer, Inc.	Lincoln, Ill.
8220	Gould-National Batteries, Inc.	St. Paul, Minn.
8698	General Mills, Inc.	Buffalo, N.Y.
9231	Graybar Electric Co.	Oakland, Cal.
9473	G.E. Distributing Corp.	Schenectady, N.Y.
9479	Security Co.	Detroit, Mich.
9665	United Transformer Co.	Chicago, Ill.
0030	United Shoe Machinery Corp.	Beverly, Mass.
0179	U.S. Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.
#0365	Belleville Speciality Tool Mfg., Inc.	Belleville, Ill.
0763	United Carr Fastener Corp.	Chicago, Ill.
0970	Bearing Engineering Co.	San Francisco, Cal.
1146	ITT Cannon Elect. Inc., Salem Div.	Salem, Mass.
1260	Connor Spring Mfg. Co.	San Francisco, Cal.
1345	Miller Dial & Nameplate Co.	El Monte, Cal.
1418	Radio Materials Co.	Chicago, Ill.
1506	Augat Inc.	Attleboro, Mass.
[illegible]	Dale Electronics, Inc.	Columbus, Nebr.
[illegible]	Elco Corp.	Willow Grove, Pa.
[illegible]	Epiphone Inc.	New York, N.Y.
1737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
1827	K F Development Co.	Redwood City, Cal.
1886	Malco Mfg., Inc.	Chicago, Ill.
91929	Honeywell Inc., Micro Switch Division	Freeport, Ill.
91961	Nahm-Bros. Spring Co.	Oakland, Cal.
92180	Tru-Connector Corp.	Peabody, Mass.
92367	Elgeet Optical Co., Inc.	Rochester, N.Y.
92607	Tensolite Insulated Wire Co., Inc.	Tarrytown, N.Y.
92702	IMC Magnetics Corp.	Westbury, L.I., N.Y.
92966	Hudson Lamp Co.	Kearney, N.J.
93332	Sylvania Electric Prod. Inc., Semiconductor Div.	Woburn, Mass.
93369	Robbins & Myers Inc.	Pallisades Park, N.J.
93410	Stemco Controls, Div. of Essex Wire Corp.	Mansfield, Ohio
93632	Waters Mfg. Co.	Culver City, Cal.
93929	G.V. Controls	Livingston, N.J.
94137	General Cable Corp.	Bayonne, N.J.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.
94148	Scientific Electronics Products, Inc.	Loveland, Colo.
94154	Wagner Elect. Corp., Tung-Sol Div.	Newark, N.J.
94197	Curtiss-Wright Corp., Electronics Div.	East Patterson, N.J.
94222	South Chester Corp.	Chester, Pa.
94330	Wire Cloth Products, Inc.	Bellwood, Ill.
94375	Automatic Metal Products Co.	Brooklyn, N.Y.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
94696	Magnecraft Electric Co.	Chicago, Ill.
95023	George A. Philbrick Researchers, Inc.	Boston, Mass.
95146	Alco Elect. Mfg. Co.	Lawrence, Mass.
95236	Allies Products Corp.	Diania, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	Long Island, N.Y.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordos Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Rolling Meadows, Ill.
95566	Arnold Engineering Co.	Marengo, Ill.
95712	Dage Electric Co., Inc.	Franklin, Ind.
95984	Siemon Mfg. Co.	Wayne, Ill.
95987	Weckesser Co.	Chicago, Ill.
96067	Microwave Assoc., West, Inc.	Sunnyvale, Cal.
96095	Hi-Q Div. of Aerovox Corp.	Olean, N.Y.
96256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.
96296	Solar Mfg. Co.	Los Angeles, Cal.
96396	Microswitch, Div. of Minn.-Honeywell	Freeport, Ill.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Cal.
96508	Xcelite, Inc.	Orchard Park, N.Y.
96733	San Fernando Elec. Mfg. Co.	San Fernando, Cal.
96881	Thomson Ind, Inc.	Long Island, N.Y.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic & Precision Mfg.	Englewood, N.J.
97979	Reon Resistor Corp.	Yonkers, N.Y.
97983	Litton System Inc., Adler-Westrex Commun. Div.	New Rochelle, N.Y.
98141	R-Tronics, Inc.	Jamaica, N.Y.
98159	Rubber Teck, Inc.	Gardena, Cal.
98220	Hewlett-Packard Co., Medical Elec. Div.	Pasadena, Cal.
98278	Microdot, Inc.	So. Pasadena, Cal.
98291	Sealectro Corp.	Mamaronech, N.Y.
98376	Zero Mfg. Co.	Burbank, Cal.
98410	Etc Inc.	Cleveland, Ohio
98731	General Mills Inc., Electronics Div.	Minneapolis, Minn.
98734	Paeco Division of Hewlett-Packard Co.	Palo Alto, Cal.
98821	North Hills Electronics, Inc.	Glen Cove, N.Y.
98978	International Electronic Research Corp.	Burbank, Cal.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Cal.
99378	Atlee Corp.	Winchester, Mass.
99515	Marshall Ind., Capacitor Div.	Monrovia, Cal.
99707	Control Switch Division, Controls Co. of America	El Segundo, Cal.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99928	Branson Corp.	Whippany, N.J.
99934	Rembrandt, Inc.	Boston, Mass.
99942	Hoffman Electronics Corp., Semiconductor Division	El Monte, Cal.
99957	Technology-Instrument Corp. of California	Newbury Park, Cal.

The following HP Vendors have no number assigned in the latest supplement to the Federal Supply Code for Manufacturers Handbook.

000F	Malco Tool and Die	Los Angeles, Calif.	000CS	Hewlett-Packard Co., Springs Div.	Colorado Springs, Colorado
000Z	Willow Leather Products Corp.	Newark, N.J.	000MM	Rubber Eng. & Development	Hayward, Cal.
00AB	ETA	England	000NN	A "N" D Mfg. Co.	San Jose, Cal.
00BB	Precision Instrument Comp. Co.	Van Nuys, Cal.	000QQ	Cooltron	Oakland, Cal.
			000WW	California Eastern Lab	Burlington, Cal.
			000YY	S.K. Smith Co.	Los Angeles, Cal.

CONDITIONS OF WARRANTY

for

Klystrons supplied by the

HEWLETT-PACKARD COMPANY

Klystrons are warranted to be free from manufacturing defects for a period of one year from the date of purchase from Hewlett-Packard.

Allowances for premature failure will be pro-rated on the basis of remaining warranted hours of heater-filament operation at the time of tube failure.

Klystron tubes are warranted by the manufacturer only to the original purchaser. For this reason, all warranty claims for premature failure of tubes supplied by Hewlett-Packard must be made to Hewlett-Packard, and not to the manufacturer. Be sure to pack the tube in accordance with the shipping instructions listed on the Warranty Claim Form; no allowance can be made for broken tubes.

In warranty tubes purchased from Hewlett-Packard may be returned, with a completed warranty Claim Form, to your local Hewlett-Packard Sales and Service Office, or to:

Hewlett-Packard Company
Customer Service Center
333 Logue Avenue
Mountain View, California 94040
USA

Or (in Western Europe)
Hewlett-Packard SA
1217 Meyrin
Geneva,
Switzerland

Instructions for filing a warranty claim are listed on the "Warranty Claim and Adjustment Procedure" form which is included in the Operating and Service Manual for your instrument. This form is also included with replacement microwave tubes supplied by Hewlett-Packard. Additional copies are available from your local Hewlett-Packard Sales and Service Office or from the Hewlett-Packard Company.

After expiration of this warranty Hewlett-Packard specified replacement tubes can be obtained from your local Hewlett-Packard Sales and Service Office or from Hewlett-Packard in Mountain View or HPSA in Western Europe.

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WARRANTY CLAIM AND ADJUSTMENT PROCEDURE

for microwave tubes supplied by the
HEWLETT-PACKARD COMPANY
for use in Hewlett-Packard instruments

The procedure described below is for use within the United States. For warranty claims arising outside the U.S.A., before returning the tube, fill out the form on the reverse side and send it with a request for shipping instructions to your nearest Hewlett-Packard Sales and Service Office or to:

(in Western Europe)

Hewlett-Packard S.A.
1217 Meyrin
Geneva, Switzerland
Telephone: (022) 41 54 00
Telex: 2.24.86
Cable: HEWPACKSA

(Rest of World)

Hewlett-Packard Co.
International Marketing Dept.
1501 Page Mill Road
Palo Alto, California, 94304, U.S.A.
Telephone: (415) 326-7000
Telex: 033811
Cable: HEWPACK

Microwave tubes supplied by the Hewlett-Packard Company, either as original or replacement, for use in Hewlett-Packard instruments are actually warranted by the tube manufacturer and not by Hewlett-Packard. However, all warranty claims on tubes obtained from us either as original or replacement will be processed by Hewlett-Packard.

In the event of failure you should purchase a new tube and return your old tube immediately to Hewlett-Packard. Credit allowances will be passed on to you upon receipt of the defective tube.

For your convenience, warranty claims for all microwave tubes supplied by the Hewlett-Packard Company may be made on this single form; merely fill out the information on the reverse side and return this form, along with the defective tube, to your Hewlett-Packard Sales and Service Office or to Hewlett-Packard. Please be sure each space on the form is filled in--lack of complete information may delay processing of your claim.

Each tube manufacturer has his own warranty policy. Copies of individual Conditions of Warranty are available from your Hewlett-Packard Sales and Service Office or from the Hewlett-Packard Company.

SHIPPING INSTRUCTIONS

The following instructions are included to aid you in preventing damage in transit. Package your tube carefully--no allowance can be made on broken tubes.

1. Carefully wrap tube in 1/4-inch thick cellulosic cushioning, cotton batting, or other soft padding material. Cable assemblies and other accessories not rigidly mounted to the tube should be padded and wrapped separately to prevent damage to the tube during shipment.
2. Wrap the above in heavy kraft paper.
3. Pack in a rigid container which is at least 4 inches larger than the tube in each dimension.
4. Surround the tube with at least 2 inches of shock absorbing material. Be certain that the packing is tight all around the tube.
5. Tubes returned from outside the continental United States should be packed in a wooden box.
6. Mark container FRAGILE and ship prepaid via Air freight or Railway Express. Do not ship via Parcel Post or Air Parcel Post since experience has shown that fragile items are more apt to be damaged when shipped by these means.

Note

Tubes with permanent magnets can interfere with magnetic compasses.
For air shipment plainly mark container: "MAGNETIZED MATERIAL"

In warranty tubes purchased from Hewlett-Packard may be returned, with a completed warranty Claim Form, to your local Hewlett-Packard Sales and Service Office, or to:

Hewlett-Packard Company
Customer Service Center
333 Logue Avenue
Mountain View, California 94040
USA

Rev 12/16/69

MICROWAVE TUBE WARRANTY CLAIM
INFORMATION FORM

IMPORTANT: Please answer all questions fully -- insufficient information may delay processing of your claim.

DATE: _____

FROM: (Tube Owner)

Company _____

Address _____

_____

_____

Tube type _____

Tube serial No. _____

Tube mfr. _____

Use in HP Model _____

Instrument serial No. _____

Tube is Original ( ) or Replacement ( )

Date tube received _____

Date of failure _____

Total hours filament operation _____

SYMPTOMS: (Please describe conditions prior to and at time of failure, along with description of tube's defect, if known) _____

_____

_____

_____

IMPORTANT:
Replacement (new) tube serial No. _____

Signature _____

Title _____

For HP use only
Repair order # _____

12/16/69

APPENDIX I

ILLUSTRATED PARTS IDENTIFICATION

MODELS 618C-620B

SHF
SIGNAL GENERATOR

Parts List for Figure I-1

REF.	STOCK NO.	DESCRIPTION	QTY.
1		See Figures 2 & 3	
2		See Figure 4	
3		See Figures 5, 6, 7 & 8	
4		See Figure 9	
5		See Figures 13, 14 & 15	

REF.	STOCK NO.	DESCRIPTION	QTY.

REF.	STOCK NO.	DESCRIPTION	QTY.

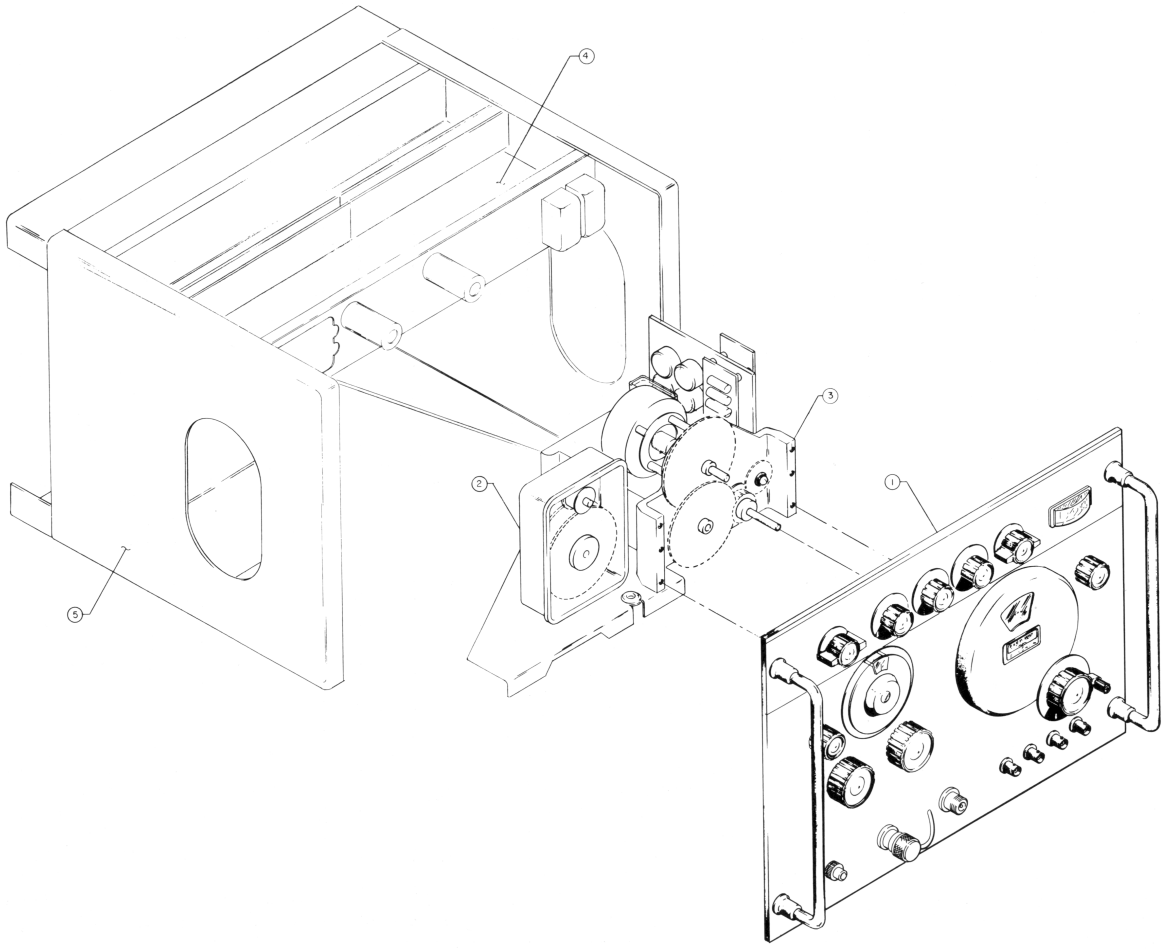

Figure I-1. HP Model 618C/620B S.H.F. Signal Generator, General Arrangement

Parts List for Figure I-2

REF.	STOCK NO.	DESCRIPTION	QTY.
1	2990-0002	Screw, Truss head ss, 10-24 thd, 1/2 in. lg	17
2	2530-0003	Screw, Flat head ss, 8-32 thd, 1/2 in. lg	4
3	2930-0004	Screw, Flat head ss, 10-24 thd, 1/2 in. lg	1
4	2550-0009	Screw, Bind. head, ss, with ext lock, 8/32 thd, 1/2 in. lg	3
5	08614-626	Cap Assy, RF Conn	1
6	2370-0001	Screw, Flat head ss, 6-32 thd, 1/4 in. lg	4
7	2210-0002	Screw, Flat head ss, 4-40 thd, 1/4 in. lg	3
8	2550-0007	Screw, Bind. head ss, with ext lock, 8-32 thd, 3/8 in. lg	1
9	0520-0025	Screw, Round head ss, 2-56 thd, 1/8 in. lg	2
10	2200-0010	Screw, Round head ss, 4-40 thd, 3/4 in. lg	4
11	3030-0001	Screw, Allen dr set, 8-32 thd, 3/16 in. lg	24
12	3050-0032	Washer, 5/16 in. od, 0.190 in. id, brass	13
13	0520-0015	Screw, Round head, 2-56 thd, 5/16 in. lg	2
14	2190-0016	Washer, Int lock, 1/2 in. od	7

REF.	STOCK NO.	DESCRIPTION	QTY.
15	2950-0001	Nut, 1/2 in. wide, 3/8-32 thd, br	7
16	0370-0035	Knob, 1 in. dia blk, 1/4 in. shaft, w/arrow	2
17		Not assigned	
18	0370-0029	Knob, 1 in. dia blk, 1/4 in. shaft, w/arrow	2
19	0370-0038	Knob, 1-5/8 in. dia blk, 1/4 in. shaft	2
20	0370-0050	Knob, 3/8 in. dia blk, crank handle	1
21	1410-0033	Bushing, Knob 0.219 od, 0.140 id	1
22	2410-0001	Screw, Oval Phillips, 6-32 thd, 5/8 in. lg	1
23	618B-40P	Dial Assy, Vernier	1
24	618B-40H	Dial, Pulse width	1
25	618B-40F	Dial, Pulse delay	1
26	618B-40G	Dial, Pulse rate	1
27	618B-3E	Handle, Panel	2
28	61B-3AT	Ferrule, Panel handle	4
29	1250-0141	Body, Clamp	2
30	1250-0142	Nut, Clamp	2
31	1250-0143	Washer, Shouldered	2
32	1250-0144	Body, Connector	2
33	1250-0145	Gasket, V groove	2
34	1250-0146	Washer, Flat	2

REF.	STOCK NO.	DESCRIPTION	QTY.
35	1250-0147	Nut, Connector	2
36	1250-0148	Washer, Insulating	2
37	1250-0017	Contact, Female	2
38	3050-0016	Washer, no. 6, 9/32 in. od, nickel pl brass	1
39	5040-0214	Bead A (618C)	2
	5040-0215	Bead C (620B) (signal side)	1
40	3101-1248	Switch, Push	1
41	5020-0234	Hub, Dial 1 in. dia	1
42	61B-40D-4	Plate, Freq dial	1
43	618B-40Q	Dial, Freq	1
44	618B-40E	Dial, Power set	1
45	618B-40C	Dial, Attenuator (618C)	1
	620A-40A	Dial, Atten. (620B)	1
46	5040-0216	Indicator, Dial marked atten	1
47	618B-47C	Spacer, Window	2
48	61B-40D-1	Window, Dial (618C)	1
	620A-40B	Window, Dial (620B)	1
49	618B-40B	Cover, Dial	1
50	61B-40B-1	Cover, Attenuator dial	1
51	00618-020	Panel, Front	1
	00618-021	Panel, Front (rack mtg)	1
52	2190-0014	Washer, Int lock 1/2 in. od	2
53	3050-0017	Washer, 3/8 in. od, 0.26 in. id, bronze	5
54	618B-16S-T-U-V	Cable Assy	4
55	2140-0244	Lamp, Glow	1

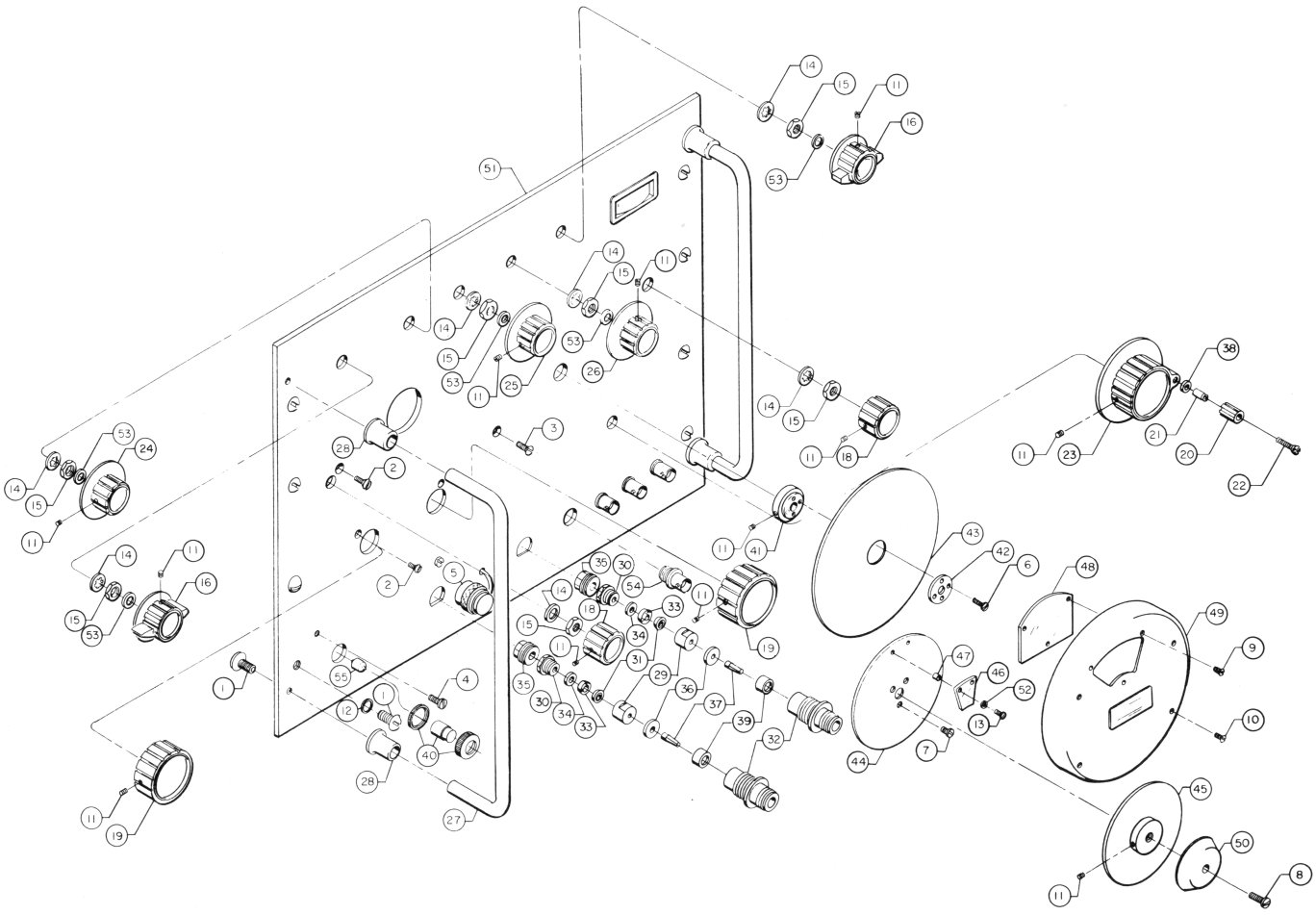

Figure I-2. HP Model 618C/620B S.H.F. Signal Generator, Control Panel, Front View

Parts List for Figure I-3

REF.	STOCK NO.	DESCRIPTION	QTY.
1	5020-0319	Shaft, 1/4 in. ss, 1-3/16 in. lg	5
2	1410-0003	Bushing, Threaded 3/8-32, 1/2 in. lg	5
3	5000-0206	Washer, Spring 9/16 in. dia	5
4	5020-0238	Head Coupler 3/4 in. dia	5
5	3030-0001	Screw, Allen dr set 8-32 thd, 3/16 in. lg	10
6	5020-0318	Shaft	5
7	2950-0042	Nut, 1 in. wide, 3/4-20 thd, br	2
8	2190-0051	Washer, Int lock 1 in. od	2
9	618B-16S-T-U-V	Cable Assy	4
10	2190-0016	Washer, Int lock 1/2 in. od	2
11	2100-0047	Resistor, Variable	2
12	3101-0107	Switch, Push	1
13	2280-0012	Screw, Round head, 4-40 thd, 3/4 in. lg	2
14	1120-1277	Meter	1

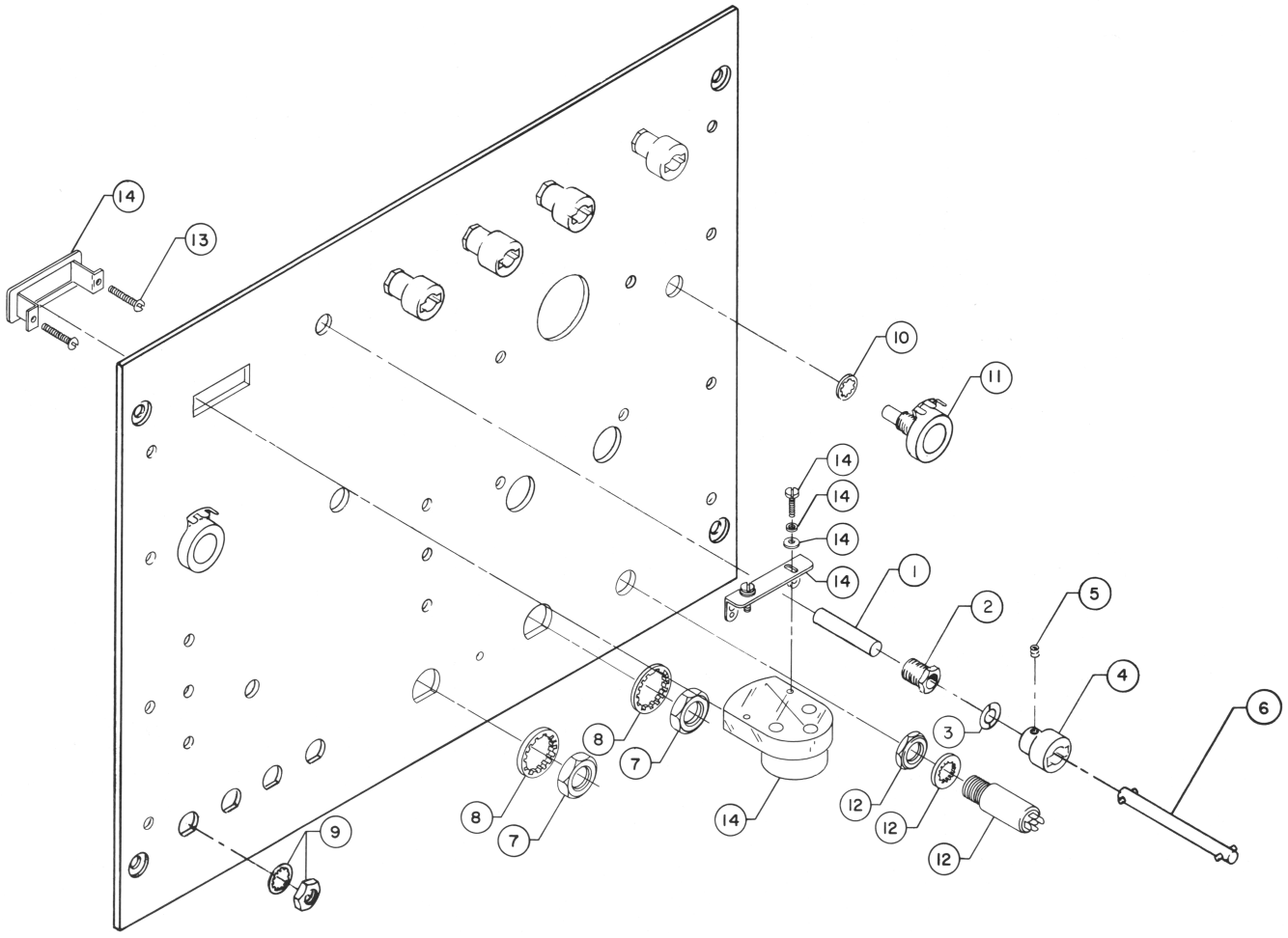

Figure I-3. HP Model 618C/620B S.H.F. Signal Generator, Control Panel, Rear View

Parts List for Figure I-4

REF.	STOCK NO.	DESCRIPTION	QTY.
1	618B-35A	Housing	1
2	618B-35B	Guide, Rack	1
3	618B-35D	Spacer, Bearing	1
4	618B-35E	Tube, Drive	1
5	618B-35G	Hub, Gear	1
6	618B-35H	Bracket, Gear	1
7	618B-35I	Shaft, Monitor	1
8	618B-35J	Shaft, Attenuator	1
9	618B-35K	Gear, Idler	1
10	618B-35L	Gear, Idler	1
11	618B-35M	Gear, Driven	1
12	618B-35N	Gear, Driven	1
13	618B-35P -S	Gear, Rack	1
14	618B-35P -L	Gear, Rack	1
15	5020-0233	Collar, 1/4 in. shaft 1/2 in. dia	4
16	5000-0206	Washer, Spring, 9/16 in. dia	4
17	5020-0256	Shaft	2
18	618B-35Q	Gear, Attenuator dial	1
19	618B-35R	Gear, Monitor	1
20	618B-35S	Gear, Drive	1
21	618B-35T	Gear, Drive	1
22	618B-35U	Gear, Drive	1
23	618B-35V	Gear, Drive	1
24	620A-91A	Spring, Rack Load	1
25	5020-1890	Bushing, 1/4 in. lg	1
26	1410-0004	Bearing, Ball, 5/8 od, 1/4 id	1
27	1410-0007	Bearing, Ball, 1/2 od, 3/16 id	2
28	1410-0012	Bearing, Ball 7/8 od, 3/8 id	2
29	1460-0048	Spring, Extension	4
30	2210-0002	Screw, Flat head ss, 4-40 thd, 1/4 in. lg	9
31	2190-0003	Washer, Split lock for no. 4 screw	3
32	2260-0001	Nut, 1/4 in. wide 4-40 thd, ss	3
33	0380-0017	Spacer	1
34	3030-0001	Screw, Allen dr set 8-32 thd, 3/16 in. lg	13
35	3030-0007	Screw, Allen dr set 4-40 thd, 1/8 in. lg	8
36	3050-0017	Washer, 3/8 in. od 0.26 in. id, bronze	A/R
37	2550-0007	Screw, Bind. head ss, 8-32 thd, 3/8 in. lg, w/ ext lock	1
38	2420-0001	Screw, Bind. head ss, 6-32 thd, 5/16 in. lg, w/ ext lock	2
39	2380-0004	Screw, Fil head ss, 6-32 thd, 3/4 in. lg	1
40	3050-0106	Washer, Brass .48 od, .338 id	6
41	3050-0074	Washer, Be Cu .75 od .255 id	1
42	3030-0003	Screw, Allen dr cap 6/32 thd, 3/8 in. lg	1
43	1400-0015	Clamp, Cable 1/4 in. dia, steel	1
44	3050-0025	Washer, Be Cu 1.25 od, .2812 id	1

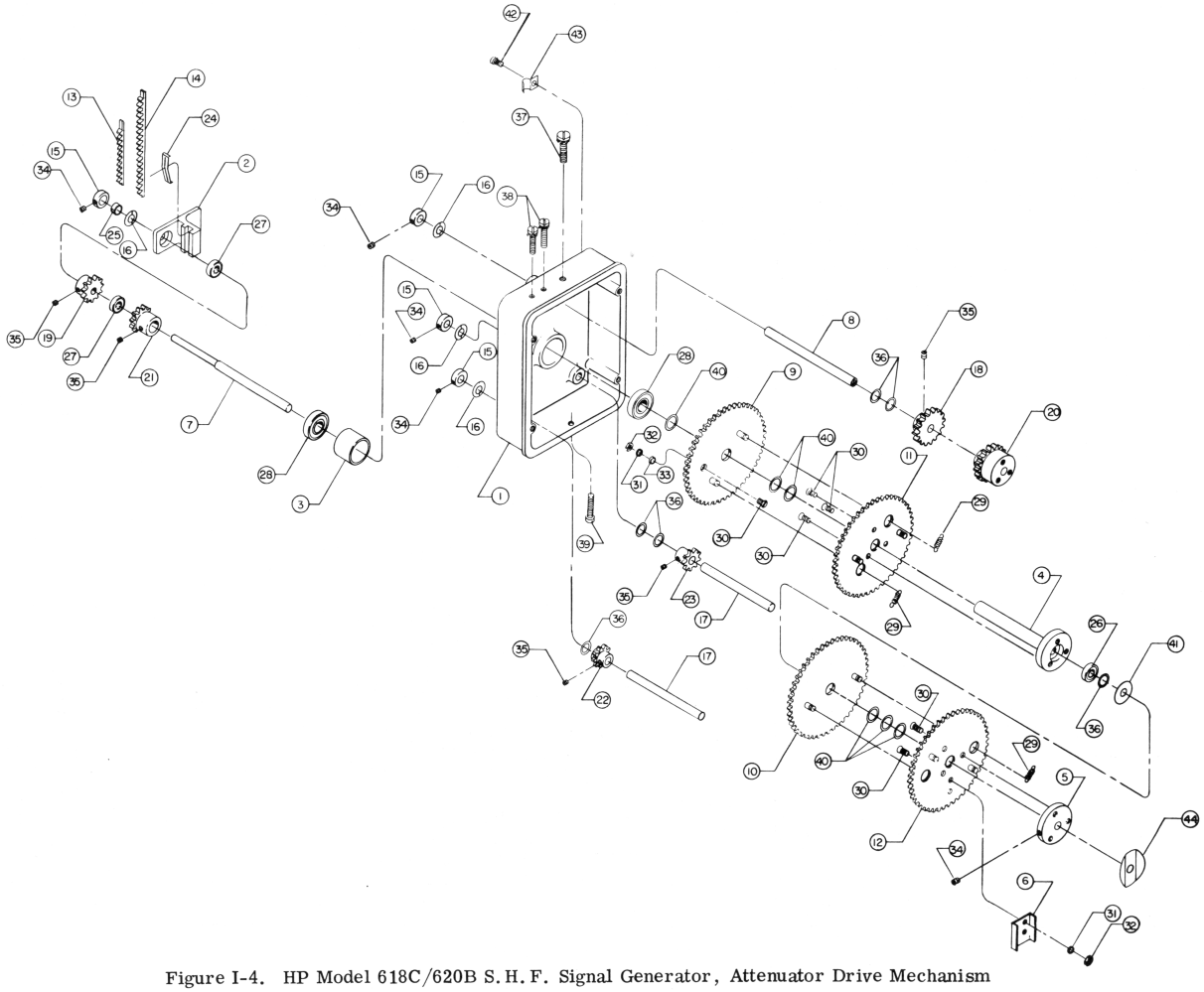

Figure I-4. HP Model 618C/620B S.H.F. Signal Generator, Attenuator Drive Mechanism

Parts List for Figure I-5

REF.	STOCK NO.	DESCRIPTION	QTY.
1	0160-0088	Capacitor, Fxd paper 0.25 uf 10% 1.5K vdcw	1
2	1210-0006	Bracket, Mtg footed CP07FA2	2
3	1410-0009	Bearing, Ball .75 od .25 bore	2
4	1460-0048	Spring, Extension .688 lg	4
5	2100-0127	Resistor, Variable 100K ohms 10%, 8w	1
6	3102-0001	Switch, SPDT	1
7	3102-0002	Lever, Switch actuator	1
8	5020-0233	Collar, 1/4 in. shaft 1/2 in. dia	2
9	5020-0278	Gear, Offset tooth	1
10	5020-0340	Shaft, 1/4 in. ss 1-5/16 in. long	1
11	5020-0349	Shaft, 2-3/4 in. long	1
12	608D-47J	Spacer, Stop gear	1
13	618B-27	Filter Assy	1
14	618B-36P	Gear, Idler	1
15	618B-36L	Retainer, Freq	2
16	618B-36Q	Gear, Freq	1
17	00618-238	Adapter	1
18	618B-36AT	Ring, Pot mounting	3
19	618B-36AX	Gear, Freq drive	1
20	618B-36N	Gear, Pot drive	1
21	618B-36R	Gear, Freq	1
22	00618-242	Coupler, Potentiometer	1
23	00618-2061	Cavity Assy	1
24	620A-36AA	Housing	1
25	618B-3D	Shield, Tube	1
26	618B-3G	Contact, Tube	2
27	618B-3C	Nut, Tube	1
28	00618-240	Board, Terminal	1
29	2100-0028	Resistor, Variable 50K ohms 10% 2.25 w	4
30	618B-34AA	Attenuator Assy	1
31	618B-3F	Spring, Tube	1
32	00618-226	Probe, Bolometer	1
33	620A-34D	Sleeve, Dielectric	1
34	1250-0005	Nut, Connector	1
35	1250-0006	Washer, Connector	1
36	1250-0007	Gasket, Connector	1
37	1250-0008	Clamp, Connector	1
38	1250-0141	Clamping Body, RF connector	1
39	1250-0142	Nut, Clamp	1
40	620A-34A -1	Stop, Attenuator	1
41	620A-28C	Stop, Plunger	1
42	618B-3A	Clamp, Guide	1
43	618B-35B	Guide, Rack	1
44	620A-91A	Spring, Rack load	1
45	618B-35P -L	Gear, Rack	1
46	618B-35P -S	Gear, Rack	1
47	618B-52A	Housing	1
48	1200-0014	Socket, 4 Pin tube ring mounting	1
49	8160-0008	Braid, RF .25 dia aluminum	6"
50	1250-0143	Washer, Shouldered	1
51	1250-0145	Gasket	1
52	00618-023	Bracket	1
53	618B-52B	Cover, Housing	1
54	5020-0621	Nut, 11/32 in. gland 9/16 in. dia	1
55	3050-0022	Washer, 7/16 in. od 5/16 in. id brass	2
56	0890-0002	Rubber, Tubing	1/4"
57	2190-0016	Washer, Int lock 1/2 in. od	6
58	2950-0001	Nut, 1/2 in. wide 3/8-32 thd, br	6
59	2950-0033	Nut, 1/2 in. wide 3/8-32 thd, br	4
60	3030-0001	Screw, Allen dr set 8-32 thd, 3/16 in. lg	13
61	3030-0007	Screw, Allen dr set 4-40 thd, 1/8 in. lg	1
62	618B-88A	Ring, Seating	1
63	1250-0146	Washer, Flat	1
64	1250-0147	Nut, Retainer	1
65	1250-0148	Washer, Insulating	1
66	1950-0004	Klystron	1
68	620A-90C	Nut, Tube collet	1
69	2360-0018	Screw, Round head ss 6-32 thd, 1-1/2 in. lg	5
70	2190-0007	Washer, Int lock for no. 6 screw	7
71	3050-0066	Washer, 3/8 in. od 0.147 in. id, brass	20
72	3030-0064	Screw, Cap sh 6-32 x .625	6
73	2920-0005	Screw, Round head ss 10-24 thd, 7/8 in. lg	1
74	2190-0011	Washer, Int lock for no. 10 screw	1
75	3050-0019	Washer, Flat brass 1/2 in. od	1
76	3050-0005	Washer, 3/8 in. od for no. 6 screw fiber	4
77	2420-0001	Nut, 5/16 in. wide ss 6-32 thd, w/lock	3
78	2580-0003	Nut, 11/32 in. wide 8-32 thd, w/lock	1
79	2390-0007	Screw, Bind. head ss 6-32 thd, 5/16 in. lg	1
80	2550-0009	Screw, Bind. head ss 8-32 thd, 1/2 in. lg	5
81	618B-47A	Support, Bracket	1
82	3030-0016	Screw, Allen dr cap 6-32 thd, 1/2 in. lg	1
83	0520-0004	Screw, Mach brs 2-56 x 3/16 fil hd sd ni-p	2
84	00618-628	Bolometer Detector Assy	1
85	1251-0234	Connector, P.C. board 6 pin	1
86	0380-0014	Spacer, 1-3/16 in. lg 1/4 in. od	3

Parts List for Figure I-5 (Cont'd)

REF.	STOCK NO.	DESCRIPTION	QTY.
87	0380-0005	Spacer, 5/16 in. lg 1/4 in. od	3
88	2190-0004	Washer, Int lock for no. 4 screw	2
89	2550-0007	Screw, Bind. head ss 8-32 thd, 3/8 in. lg	6
90	2190-0009	Washer, Int lock for no. 8 screw	2
91	0380-0003	Spacer, 1/4 in. od., 1/8 in. lg	1
92	2390-0009	Screw, Bind. head ss 6-32 thd, 3/8 in. lg	6
93	2220-0003	Screw, Fil head ss 4-40 thd, 5/16 in. lg	3
94	3050-0229	Washer, 0.250 in. od, 0.117 in. id, ss	1
95	2190-0061	Washer, Split lock for no. 4 screw	1
96	2200-0006	Screw, Round head, ss, 4-40 thd, 3/8 in. lg	3

REF.	STOCK NO.	DESCRIPTION	QTY.
97	00618-632	Board Assy, Bolometer amplifier	1
98	00618-640	Sample Probe Assy	1
99	2370-0003	Screw, Flat head ss 6-32 thd, 1/2 in. lg	6
100	0400-0001	Grommet, Rubber for 3/4 in. hole	1
101	0360-0064	Board, Terminal	1
102	2520-0002	Screw, Round head ss 8-32 thd, 3/8 in. lg	2
103	3050-0014	Washer, 3/8 in. od 0.26 in. id, bronze	4
104	0360-0023	Strip, 7 terminal 5 ins, 2 gnd	2
105	2190-0010	Washer, Ext lock for no. 8 screw	4
106	00618-034	Plate, Guard	1
107	2380-0007	Screw, Fillister head, 6-32 thd, 1-1/4 in. lg	2

REF.	STOCK NO.	DESCRIPTION	QTY.
108	0380-0013	Spacer, 1/4 in. od, 1 in. lg	2
109	2190-0496	Washer, Flat Silicone Rubber; .85 ID, .975 OD, .06 thick	
110	2190-0006	Washer, Split lock for no. 6 screw	2
111	2390-0010	Screw, Bind. head ss, 6-32 thd, 1/2 in. lg	1
112	1400-0015	Clamp, Cable 1/4 in. dia cad pl s	2
113	2420-0002	Nut, 6-32 thd x 5/16 in. ss	5
114	5060-0016	Washer, no. 6, 9/32 in. od, nickel pl brass	1
115	2360-0015	Screw, Round head ss, 6-32 thd, 1-1/8 in. lg.	2
116	2360-0013	Screw, Round head ss, 6-32 thd, 1 in. lg	
117	00618-2059	Tube, Atten	1

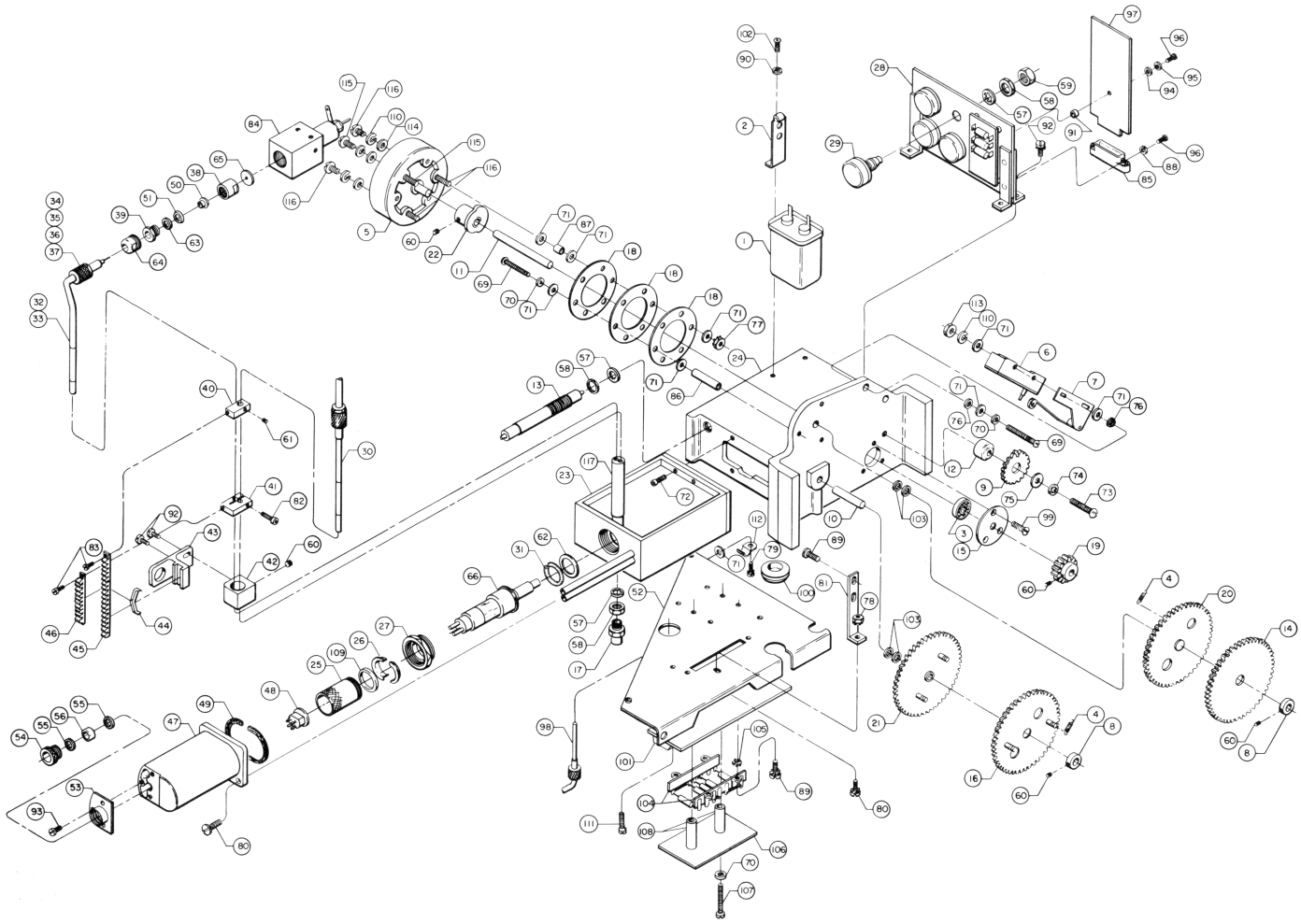

Figure I-5. HP Model 618C S.H.F. Signal Generator, Klystron Assembly and Drive Mechanism

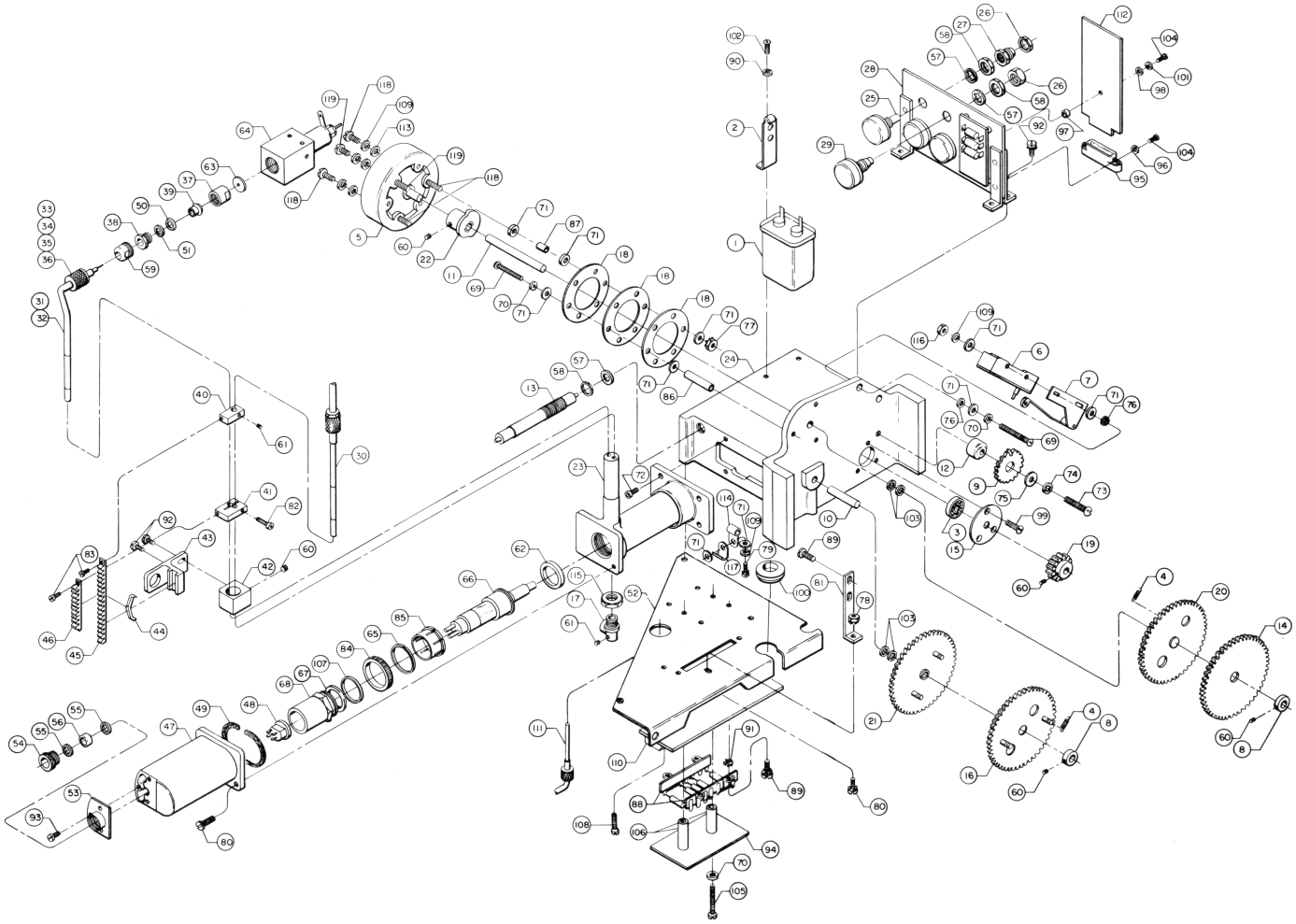

Figure I-6. HP Model 620B S.H.F. Signal Generator, Klystron Assembly and Drive Mechanism

Parts List for Figure I-6

REF.	STOCK NO.	DESCRIPTION	QTY.
1	0160-0088	Capacitor, Fxd paper 0.25 uf 10% 1.5K vdcw	1
2	1210-0006	Bracket, Mtg footed CP07FA2	2
3	1410-0009	Bearing, Ball .75 od .25 bore	2
4	1460-0048	Spring, Extension .688 lg	4
5	2100-0120	Resistor, Variable 100K ohms 5%, 8 w	1
6	3102-0001	Switch, SPDT	1
7	3102-0002	Lever, Switch actuator	1
8	5020-0233	Collar, 1/4 in. shaft 1/2 in. dia	2
9	5020-0277	Gear, Offset tooth	1
10	5020-0340	Shaft, 1/4 in. ss 1-5/16 in. long	1
11	5020-0349	Shaft, 2-3/4 in. long	1
12	608D-47J	Spacer, Stop gear	1
13	618B-27	Filter Assy	1
14	618B-35L	Gear, Idler	1
15	618B-36L	Retainer, Freq	2
16	618B-36Q	Gear, Freq	1
17	00620-224	Adapter	1
18	618B-36AT	Ring, Pot mounting	3
19	618B-36AX	Gear, Freq drive	1
20	620A-36P	Gear, Pot drive	1
21	620A-36R	Gear, Freq	1
22	00620-242	Coupler, Potentiometer	1
23	620A-36Y	Cavity Assy	1
24	620A-36AA	Housing	1
25	2100-0045	Resistor, Variable 100K ohms, 10%, 1.12 w	1
26	0590-0035	Nut, for locking bush.	4
27	0590-0036	Bushing, Locking	1
28	00618-240	Board, Terminal	1
29	2100-0028	Resistor, Variable 50K ohms 10%, 2.25 w	3 1
30	620A-34BB	Attenuator Assy	1
31	620A-28N	Bolometer Plunger Assy	1
32	620A-34D	Sleeve, Dielectric	1
33	1250-0005	Nut, Connector	1
34	1250-0006	Washer, Connector	1
35	1250-0007	Gasket, Connector	1
36	1250-0008	Clamp, Connector	1
37	1250-0141	Clamping Body, RF connector	1
38	1250-0142	Nut, Clamp	1
39	1250-0143	Washer, Shouldered	1
40	620A-34A -1	Stop, Attenuator	1
41	620A-28C	Stop, Plunger	1
42	618B-3A	Clamp, Guide	1
43	618B-35B	Guide, Rack	1
44	620A-91A	Spring, Rack load	1
45	618B-35P -L	Gear, Rack	1
46	618B-35P -S	Gear, Rack	1
47	618B-52A	Housing	1
48	1200-0014	Socket, 4 Pin tube ring mounting	1
49	8160-0008	Braid, RF .25 dia aluminum	6"
50	1250-0145	Gasket	1
51	1250-0146	Washer, Flat	1
52	00618-023	Bracket	1
53	618B-52B	Cover, Housing	1
54	5020-0621	Nut, 11/32 in. gland 9/16 in. dia	1
55	3050-0022	Washer, 7/16 in. od 5/16 in. id brass	2
56	0890-0002	Rubber, Tubing	1/4"
57	2190-0016	Washer, Int lock 1/2 in. od	5
58	2950-0001	Nut, 1/2 in. wide 3/8-32 thd, br	5
59	1250-0147	Nut, Retainer	1
60	3030-0001	Screw, Allen dr set 8-32 thd, 3/16 in. lg	13
61	3030-0007	Screw, Allen dr set 4-40 thd, 1/8 in. lg	2
62	618B-88A	Ring, Seating	1
63	1250-0148	Washer, Insulating	1
64	00618-628	Bolometer Detector Assy	1
65	0510-0779	Ring, Lock	1
66	1950-0017	Tube, Klystron	1
67	620A-90D	Ring, Washer Telfon	1
68	620A-90C	Nut, Tube collet	1
69	2360-0018	Screw, Round head ss 6-32 thd, 1-1/2 in. lg	5
70	2190-0007	Washer, Int lock for no. 6 screw	7
71	3050-0066	Washer, 3/8 in. od 0.147 in. id, brass	20
72	3030-0064	Screw, Cap sh 6-32 x .625	4
73	2920-0005	Screw, Round head ss 10-24 thd, 7/8 in. lg	1
74	2190-0011	Washer, Int lock for no. 10 screw	1
75	3050-0019	Washer, Flat brass 1/2 in. od	1
76	3050-0005	Washer, 3/8 in. od for no. 6 screw fiber	4
77	2420-0001	Nut, 5/16 in. wide ss 6-32 thd, w/lock	3
78	2580-0003	Nut, 11/32 in. wide 8-32 thd, w/lock	1
79	2390-0010	Screw, Bind. head ss 6-32 thd, 1/2 in. lg	1
80	2550-0009	Screw, Bind. head ss 8-32 thd, 1/2 in. lg	5
81	618B-47A	Support, Bracket	1
82	3030-0016	Screw, Allen dr cap 6-32 thd, 1/2 in. lg	1
83	0520-0004	Screw, Mach brs 2-56 x 3/16 fil hd sd ni-p	2
84	00620-201	Ring, Collet	1

Parts List for Figure I-6 (Cont'd)

REF.	STOCK NO.	DESCRIPTION	QTY.
85	00620-200	Collet, Tube	1
86	0380-0014	Spacer, 1-3/16 in. lg 1/4 in. od	3
87	0380-0005	Spacer, 5/16 in. lg 1/4 in. od	3
88	0360-0023	Strip, 7 terminal 5 ins, 2 gnd	2
89	2550-0007	Screw, Bind. head ss, 8-32 thd, 3/8 in. lg	6
90	2190-0009	Washer, Int lock for no. 8 screw	2
91	2190-0010	Washer, Ext lock for no. 8 screw	4
92	2390-0009	Screw, Bind. head ss, 6-32 thd, 3/8 in. lg	6
93	2220-0003	Screw, Fil head ss, 4-40 thd, 5/16 in. lg	3
94	00618-034	Plate, Guard	1
95	1251-0234	Connector, P.C. board 6 pin	1
96	2190-0004	Washer, Int lock for no. 4 screw	2
97	0380-0003	Spacer, 1/4 in. od, 1/8 in. lg	1
98	3050-0229	Washer, 0.250 in. od, 0.117 in. id, ss,	1
99	2370-0003	Screw, Flat head ss, 6-32 thd, 1/2 in. lg	6
100	0400-0001	Grommet, Rubber for 3/4 in. hole	1
101	2190-0061	Washer, Split lock for no. 4 screw	1
102	2520-0002	Screw, Round head ss, 8-32 thd, 3/8 in. lg	2
103	3050-0014	Washer, 3/8 in. od, 0.26 in. id, bronze	4
104	2200-0006	Screw, Round head ss, 4-40 thd, 3/8 in. lg	3
105	2380-0007	Screw, Fillister head, 6-32 thd, 1-1/4 in. lg	2
106	0380-0013	Spracer, 1/4 in. od, 1 in. lg	2
107	2190-0496	Washer, Flat Silicone Rubber; .85 ID, .975 OD, .06 thick	1
108	2390-0010	Screw, Bind, head ss, 6-32 thd, 1/2 in. lg	2
109	2190-0006	Washer, Split lock for no. 6 screw	8
110	0360-0064	Board, Terminal	1
111	00620-624	Sample Probe Assy	1
112	00618-632	Board Assy, Bolometer amplifier	1
113	3050-0016	Washer, no. 6, 9/32 in. od, nickel pl brass	5
114	1400-0016	Clamp, Cable 9/16 in. dia nylon	1
115	2950-0002	Nut, 7/16-20 thd, nickel pl brass	1
116	2420-0002	Nut, 6-32 thd x 5/16 in. ss	2
117	1400-0015	Clamp, Cable 1/4 in. dia cad pl s	1
118	2360-0013	Screw, Round head ss, 6-32, thd, 1 in. lg	2
119	2360-0015	Screw, Round head ss, 6-32 thd, 1-1/8 in. lg	1

Parts List for Figure I-7

REF.	STOCK NO.	DESCRIPTION	QTY.
1	620A-36AA	Housing	1
2	00618-204	Drive Screw and Nut	1
3	618B-36D	Guide, Frequency	2
4	618B-36F	Spacer, Rod	6
5	618B-36L	Retainer, Frequency	2
6	618B-36AD	Bar, Stop	1
7	618B-36AE	Spacer, Stop	3
8	618B-36E	Rod, Connecting	4
9	618B-36G	Bar, Plunger	1
10	618B-36AJ	Pin, Link	2
11	620A-36BB	Plate, Cover	1
12	618B-36T	Cavity Assy	1
13	1410-0009	Bearing, Ball .75 od .25 bore	2
14	1460-0041	Spring, Extension 1.875 in. lg	2
15	2390-0007	Screw, Bind. head ss 6-32 thd, 5/16 in. lg	11
16	3050-0066	Washer, 3/8 in. od 0.147 in. id, brass	8
17	3050-0014	Washer, 3/8 in. od 0.26 in. id, bronze	4
18	2680-0172	Screw, Hex head ss	2
19	2190-0034	Washer	2
21	0360-0036	Terminal, Lug, brass angle type	4
22	2370-0003	Screw, Flat head ss 6-32 thd, 1/2 in. lg	6
23	1400-0015	Clamp, Cable 1/4 in. dia, steel	1
24	2360-0011	Screw, Round head ss 6-32 thd, 3/4 in. lg	3
25	2390-0009	Screw, Bind. head ss 6-32 thd, 3/8 in. lg	4
26	2190-0007	Washer, Int lock for no. 6 screw	3
27	8160-0008	Braid, RF .25 dia aluminum	1
28	3030-0001	Screw, Allen dr set 8-32 thd, 3/16 in. lg	2
29	618B-36Z	Conductor, Center	1
30	618B-36AA	Plate, Back	1
31	618B-36AK	Filter, Repeller assy	1
32	618B-36BC	Plunger Assy	1

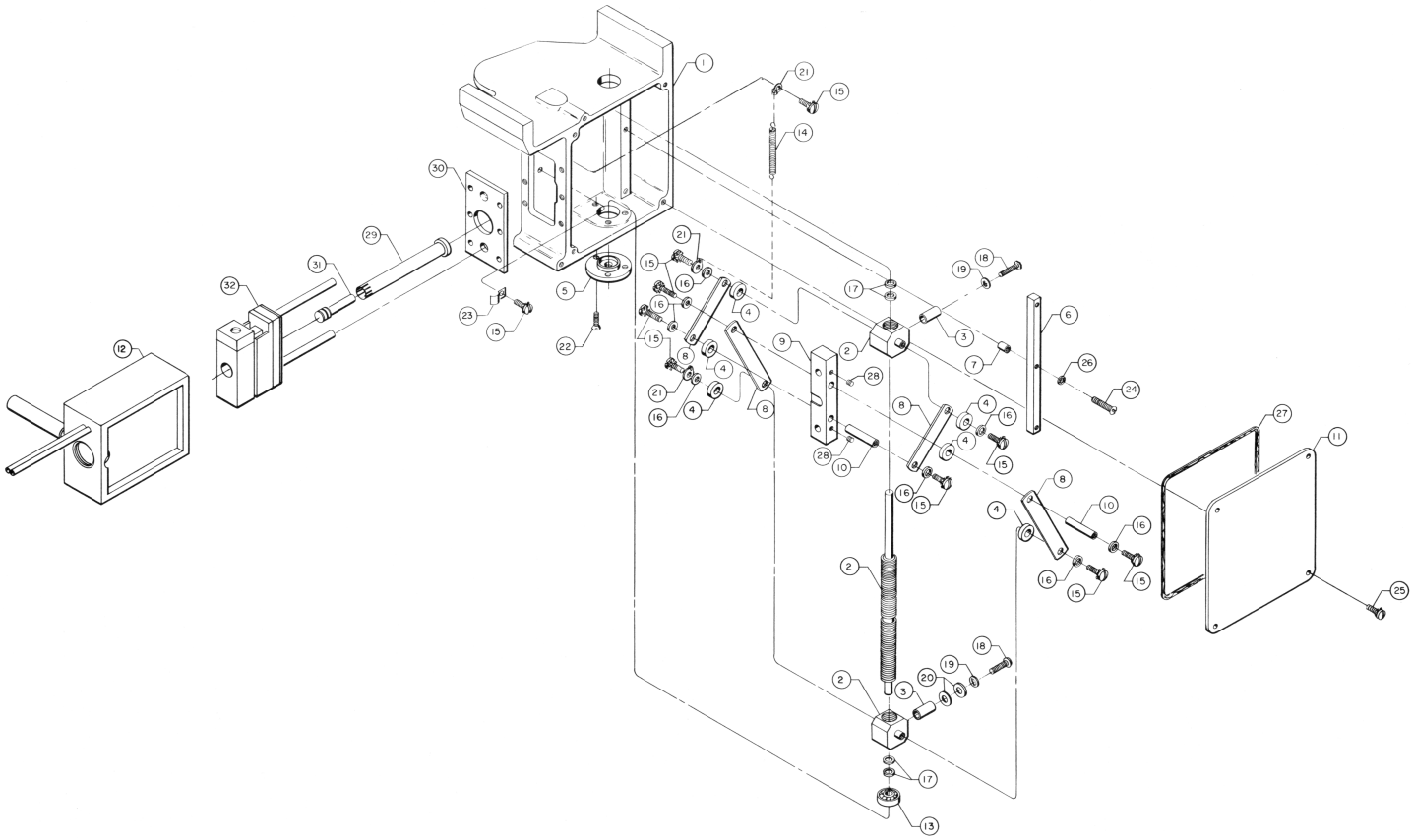

Figure I-7. HP Model 620B S.H.F. Signal Generator, Frequency Drive Mechanism

Parts List for Figure I-8

REF.	STOCK NO.	DESCRIPTION	QTY.
1	620A-36AA	Housing	1
2	00618-204	Drive Screw and Nut	1
3	618B-36D	Guide, Frequency	2
4	618B-36F	Spacer, Rod	4
5	618B-36L	Retainer, Frequency	2
6	618B-36AD	Bar, Stop	1
7	618B-36AE	Spacer, Stop	3
8	620A-36C	Rod, Connecting	4
9	620A-36D	Bar, Plunger	1
10	620A-36F	Pin, Plunger	2
11	620A-36G	Plate, Drive	1
12	620A-36H	Conductor, Center	1
13	620A-36J	Plunger Assy	1
14	620A-36L	Pin, Link	1
15	620A-36BB	Plate, Cover	1
16	1410-0009	Bearing, Ball .75 od .25 bore	2
17	620A-36Y	Cavity Assy	1
18	1460-0041	Spring, Extension 1.875 lg	2
19	2220-0005	Screw, Fil head ss, 4-40 thd, 5/8 in. lg	2
20	2390-0007	Screw, Bind. head ss, 6-32 thd, 5/16 in. lg	9
21	3050-0066	Washer, 3/8 in. od 0.147 in. id, brass	6
22	3030-0030	Screw, Allen dr cap 6-32 thd, 1 in. lg	1
23	3050-0014	Washer, 3/8 in. od 0.26 in. id, bronze	4
24	2680-0172	Screw, Hex head ss, 10-24 thd, 3/4 in. lg	2
25	2190-0034	Washer	2
27	0360-0036	Terminal lug brass angle type	4
28	2370-0003	Screw, Flat head ss, 6-32 thd, 1/2 in. lg	6
29	1400-0054	Clamp, Cable 1/8 in. dia, steel	1
30	3030-0007	Screw, Allen dr set 4-40 thd, 1/8 in. lg	4
31	2360-0011	Screw, Round head ss, 6-32 thd, 3/4 in. lg	3
32	2390-0009	Screw, Bind. head ss, 6-32 thd, 3/8 in. lg	4
33	2190-0007	Washer, Int lock for no. 6 screw	3
34	8160-0008	Braid, RF .25 dia aluminum	1
35	620A-36M	Filter, Repeller	1

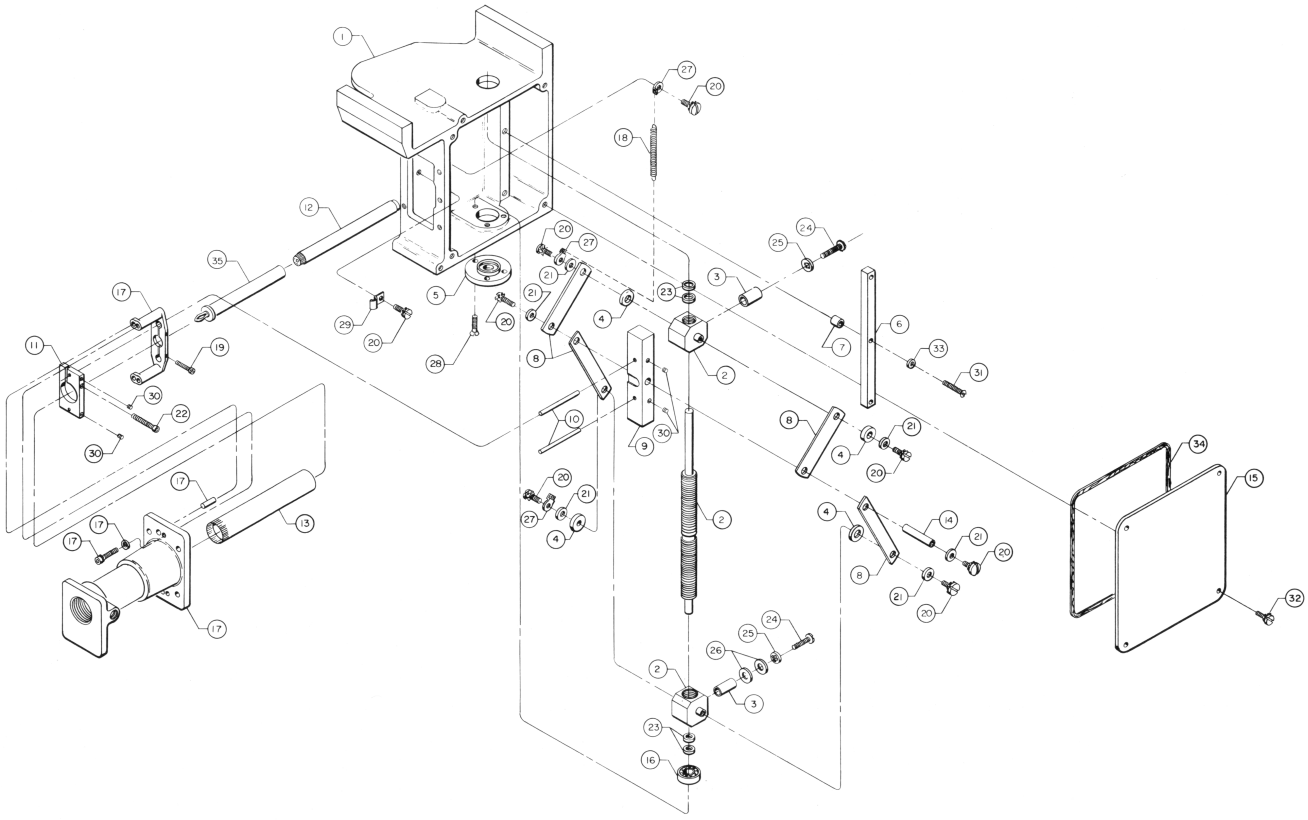

Figure I-8. HP Model 618C S.H.F. Signal Generator, Frequency Drive Mechanism

Parts List for Figure I-9

REF.	STOCK NO.	DESCRIPTION	QTY.
1		See Figure 10	
2		See Figure 11	
3		See Figure 12	

REF.	STOCK NO.	DESCRIPTION	QTY.

REF.	STOCK NO.	DESCRIPTION	QTY.

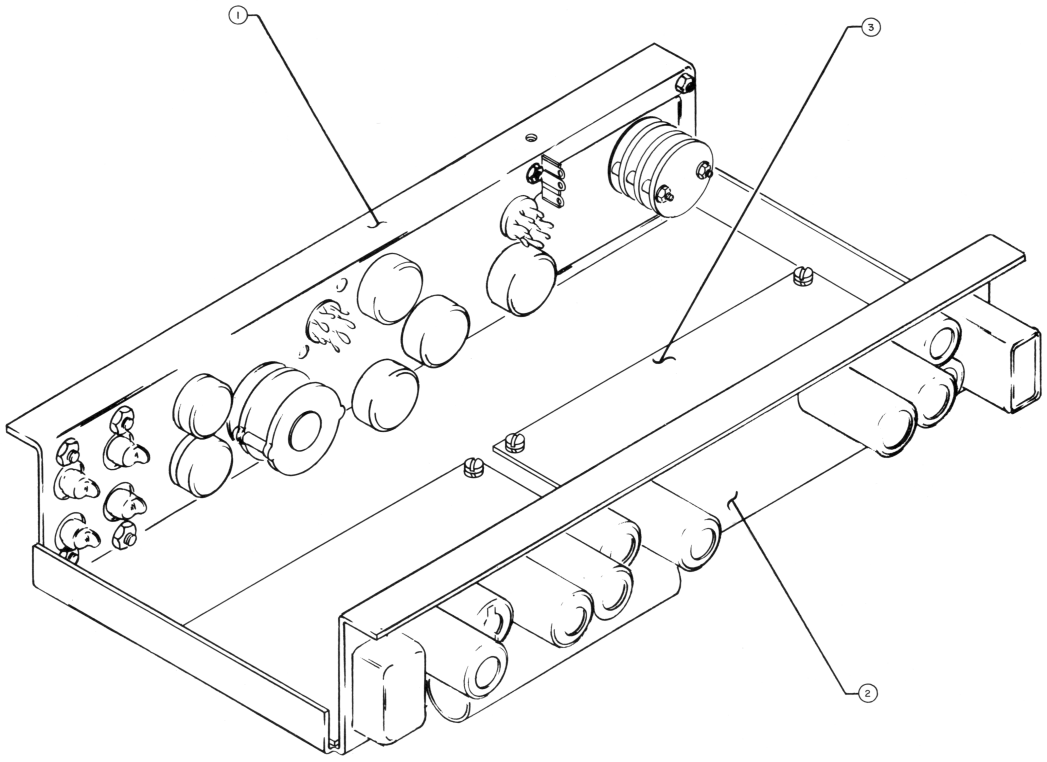

Figure I-9. HP Model 618C/620B S.H.F. Signal Generator, Pulser Section Index

Parts List for Figure I-10

REF.	STOCK NO.	DESCRIPTION	QTY.
1	2950-0001	Nut, 1/2 in. wide 3/8-32 thd, br	8
2	2190-0006	Washer, Split lock for no. 6 screw	5
3	3050-0066	Washer, 3/8 in. od 0.147 in. id, brass	5
4	2190-0022	Washer, Int. lock 11/16 in. od	8
5	3100-0076	Switch, Rotary 4 sect, 8 pos	1
6	00618-0049	Bracket, Modulator	1
7	1200-0003	Socket, 9 pin tube	2
8	3100-0075	Switch Rotary 2 sect, 5 pos	1
9	2390-0010	Screw, B.H. ss 6-32 x .5	4
10	2420-0001	Nut, 5/16 in. wide ss 6-32 thd, w/lock	9
11	2100-0025	Resistor, Variable 1.5K ohms, 10%, 2.25 w	1
12	2100-0059	Resistor, Variable 3 x 1 meg ohms 10% 2 w	1
13	2100-0051	Resistor, Variable 20K ohms, 10%, 1.12 w	1
14	2100-0047	Resistor, Variable 1 meg ohm 20% 1.12 w	1
15	2100-0029	Resistor, Variable 250K ohms, 10%, 2.25 w	2
16	2190-0008	Washer, Ext lock for no. 6 screw	6
17	0160-0081	Capacitor, Fxd paper 0.25 uf 10% 1K vdcw	2
18	2390-0009	Screw, Bind. head ss, 6-32 thd, 3/8 in. lg	5
19	2950-0033	Nut, 1/2 in. wide, 3/8-32 thd, br	3
20	5020-0238	Head, Coupler 3/4 in. dia	4
21	3030-0001	Screw, Allen dr set 8-32 thd, 3/16 in. lg	10
22	1932-0046	Tube, Electron 12AU7	2
23	1220-0009	Shield, Tube 9 pin 1-15/16 in. h	2
24	618B-16S	Cable Assy	1
25	618B-52	Socket Assy	1
28	1400-0031	Clamp, Cable 3/8 in. dia nylon	1
29	0360-0015	Strip, 3 terminal 2 ins 1 gnd	1
31	5040-0224	Head, Coupler	1
36	0360-0031	Lug, Terminal for no. 6 screw	1

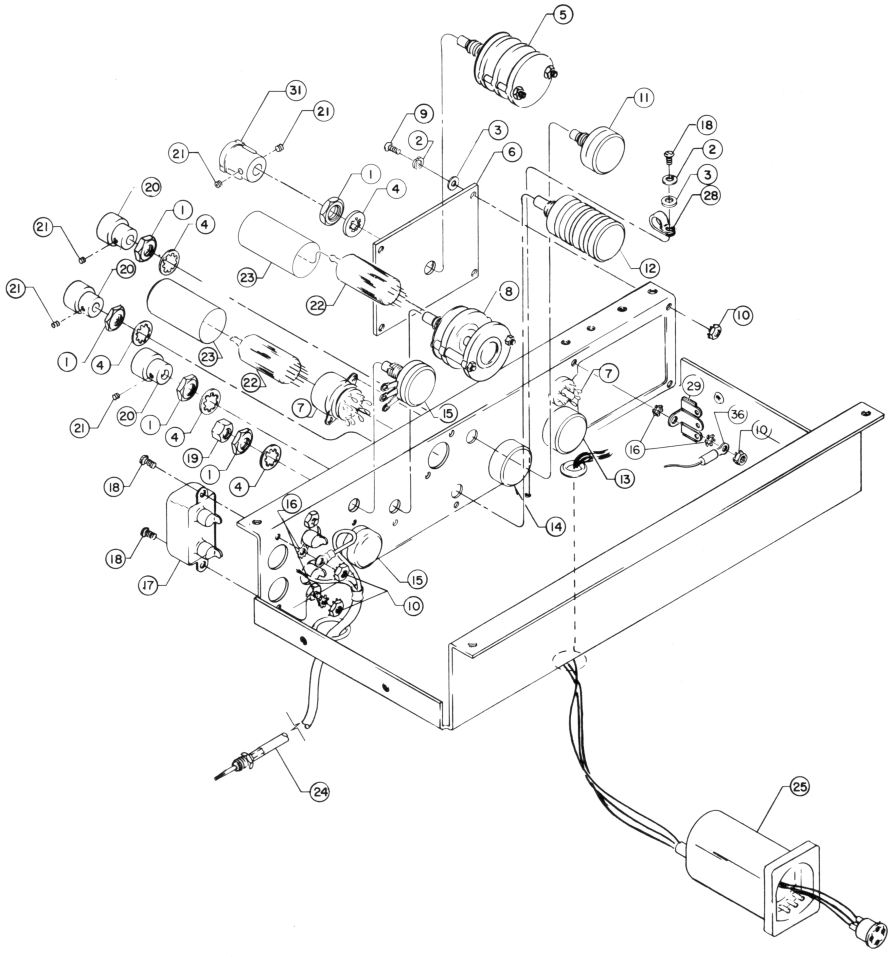

Figure I-10. HP Model 618C/620B S.H.F. Signal Generator, Partial Rear View, Pulser Section

Parts List for Figure I-11

REF.	STOCK NO.	DESCRIPTION	QTY.
1	618B-4A	Chassis	1
2	2360-0020	Screw, Round head ss 6-32 thd, 2 in. lg	2
3	2390-0007	Screw, Bind. head ss 6-32 thd, 5/16 in. lg w/ext lock	2
4	2100-0025	Resistor, Variable 1.5K ohms 10%, 2.25 w	2
5	2740-0003	Nut, 3/8 in. wide 10-32 thd w/lock	2
6	3050-0066	Washer, 3/8 in. od 0.147 id brass	6
7	0360-0009	Lug, Terminal for no. 6 screw	1
8	0340-0020	Insulator, Ceramic 3/8 in. od, 3/4 in. lg	1
9	2420-0001	Nut, 5/16 in. wide ss 6-32 thd, w/lock	2
10	1220-0009	Shield, Tube 9 pin 1-15/16 in. h	6
11	1220-0011	Shield, Tube, 7 pin 1-3/8 in. h	3
12	1200-0003	Socket, 9 pin tube	6
13	0160-0088	Capacitor, Fxd. paper 0.25 uf 10% 1.5K vdcw	1
14	2190-0022	Washer, Int lock 11/16 in. od	2
15	2950-0001	Nut, 1/2 in. wide 3/8-32 thd, br	2
16	2950-0033	Locknut, 1/2 in. wide 3/8-32 thd, br	2
17	0160-0081	Capacitor, Fxd paper 0.25 uf 10% 1K vdcw	1
18	2390-0009	Screw, Bind. head ss 6-32 thd, 3/8 in. lg w/ext lock	2
19	1932-0046	Tube, Electron 12AU7	5
20	1210-0007	Bracket, Mtg Sing. Spade Lug	2
21	0380-0002	Spacer, 1/4 in. lg 1/4 in. od	2
22	2190-0006	Washer, Split lock for no. 6 screw	4
23	2420-0002	Nut, 5/16 in. wide 6-32 thd, ss	2
24	1200-0017	Socket, 7 pin, tube shield base	4
25	1930-0013	Tube, Electron 6AL5	3
26	618B-38	Wrench, Tube	1
27	0510-0109	Nut, Wing, 6-32 thread	2
28	0361-0008	Rivet, Semitublar ch 1/8 L	20
29	1220-0010	Shield, Tube 7 pin 1-3/4 in. h	1
30	1932-0045	Tube, Electron 12AT7	1
31	1941-0005	Tube, Electron 5727 or 2D21W	1

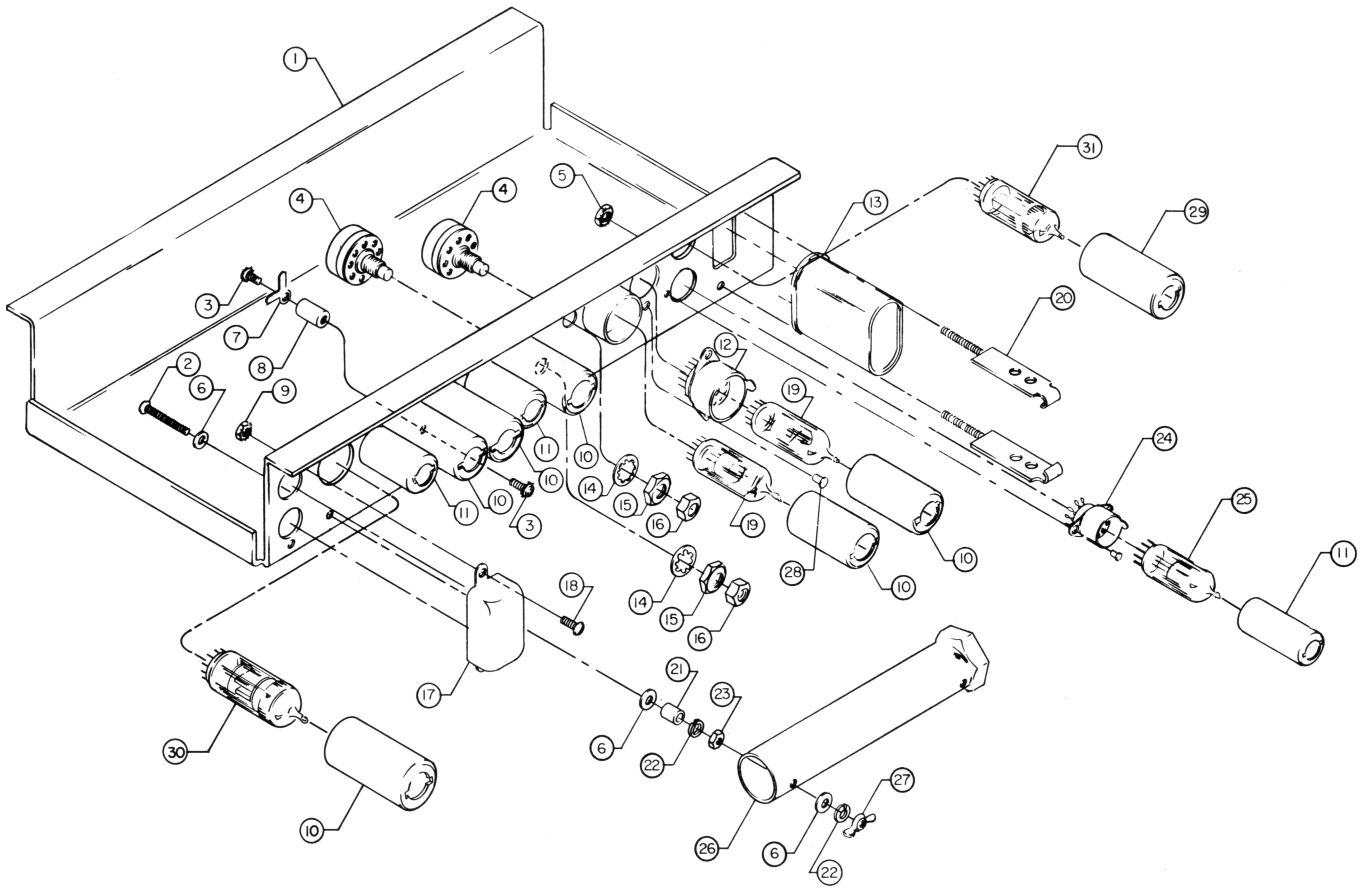

Figure I-11. HP Model 618C/620B S.H.F. Signal Generator, Partial Rear View, Pulser Section

Parts List for Figure I-12

REF.	STOCK NO.	DESCRIPTION	QTY.
1	2390-0009	Screw, Bind. head ss 6-32 thd, 3/8 in. lg	5
2	0360-0042	Lug, Terminal 90° angle	2
3	2190-0008	Washer, Ext lock for no. 6 screw	4
4	0160-0090	Capacitor, Fxd paper 0.1 uf 10%, 1K vdcw	1
5	00618-6077	Board Assembly	1
6	00618-6078	Board Assembly	1
7	618B-4A	Chassis	1
8	0160-0089	Capacitor, Fxd paper 2 x 0.1 uf 1000 vdcw	1
9	0160-0087	Capacitor, Fxd paper 0.5 uf 10% 600 vdcw	1
10	2360-0205	Screw, pan hd. 6-32 thd., 3/4 "lg	9
11	2190-0006	Washer, Split lock for no. 6 screw	9
15	2390-0007	Screw, Bind. head ss 6-32 thd, 5/16 in. lg	5

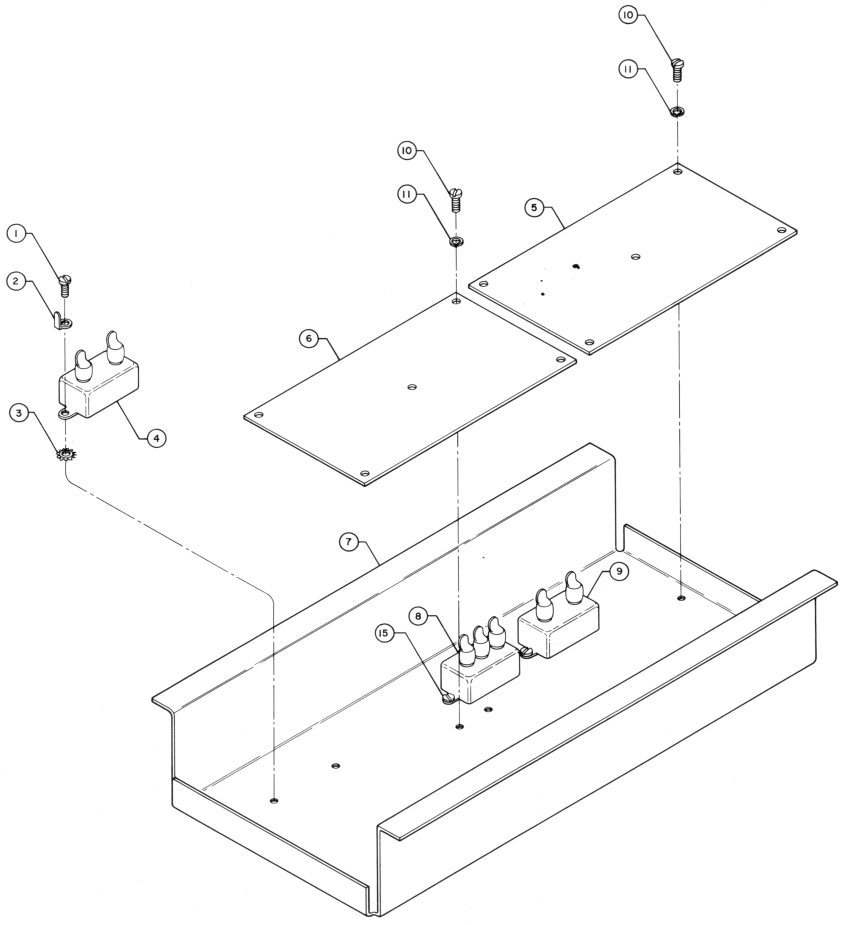

Figure I-12. HP Model 618C/620B S.H.F. Signal Generator, Partial Rear View, Pulser Section

Parts List for Figure I-13

REF.	STOCK NO.	DESCRIPTION	QTY.
1	0160-0102	Capacitor, Fxd paper 4 uf 10% 1K vdcw	3
2	0180-0128	Capacitor, Fxd electrolytic 2800 uf 30 vdcw	1
3	0180-0024	Capacitor, Fxd electrolytic 40 uf 450 vdcw	5
4	00618-022	Chassis, Power	1

REF.	STOCK NO.	DESCRIPTION	QTY.

REF.	STOCK NO.	DESCRIPTION	QTY.

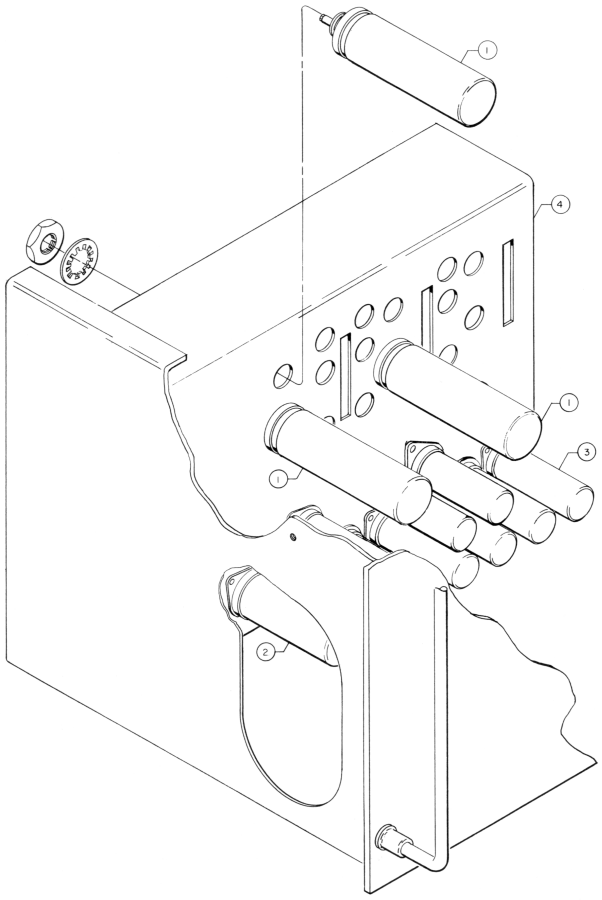

Figure I-13. HP Model 618C/620B S.H.F. Signal Generator, Chassis, Front View

Parts List for Figure I-14

REF.	STOCK NO.	DESCRIPTION	QTY.
1	00618-6060	Board Assy, -300 VPS	1
2	00618-6061	Board Assy, -1000 VPS	1
3	00618-6062	Board Assy, -1550 VPS	1
4	9100-1703	Transformer, Power	1
5	2940-0005	Screw, Truss head ss, 1/4-20 thd, 3/4 in. lg	4
6	2190-0032	Washer, Split lock for 1/4-20 screw	4
7	2950-0004	Nut, 7/16 in. wide, 1/4-20 thd ss	4
8	00618-030	Bracket, Transformer support	1
9	2990-0002	Screw, Truss head ss, 10-24 thd, 1/2 in. lg	31
10	2980-0002	Nut, 3/8 in. wide, 10-24 thd, w/lock	10
			1
12	2550-0007	Screw, Bind. head ss, 8-32 thd, 3/8 in. lg w/lock	1
13	2190-0010	Washer, Ext lock for no. 8 screw, .851 in. od	1
14	2580-0003	Nut, 11/32 in. wide, 8-32 thd, w/ext lock	1
15	2520-0019	Screw, Round head ss, 8-32 thd, 4-1/2 in. lg	1
			1
17	2580-0003	Nut, 11/32 in. wide, 8-32 thd, w/ext lock	1
			1
			1
20	2360-0011	Screw, Round head ss, 6-32 thd, 3/4 in. lg	2
21	2190-0006	Washer, Split lock for no. 6 screw	2
22	3050-0016	Washer, no. 6, 9/32 in. od, brass	2

REF.	STOCK NO.	DESCRIPTION	QTY.
23	2420-0003	Nut, 1/4 in. wide, 6-32 thd	2
24	9100-2887	Filter, Line	1
25	2550-0007	Screw, Bind. head ss, 8-32 thd, 3/8 in. lg w/ext lock	2
26	2580-0003	Nut, 11/32 in. wide, 8-32 thd, w/lock	2
27	0360-0015	Strip, 3 terminal, 2 ins, 1 gnd	1
28	2270-0001	Screw, Bind. head ss, 6-32 thd, 5/16 in. lg	1
29	2190-0004	Washer, Int lock for no. 4 screw	2
30	2260-0002	Nut, 3/16 in. wide, 4-40 thd	1
31	2110-0003	Fuse, Cartridge 3.0 amp	1
	2110-0338	Fuse, Cartridge 1.6 amp	1
32	1400-0084	Fuseholder, Post type 2-5/64 in. lg	1
33	1251-1036	Connector, 7 contact female	1
34	00618-00070	Bracket, Fan	1
35	2190-0034	Washer, Split lock for no. 10 screw	21
36	1251-2357	Connector, 3 contact ac power receptacle	1
37	3101-1234	Switch, Slide DPDT	1
38	618B-12D	Bracket, Cabinet	2
39	618B-12E	Bracket, Cabinet	2
40	00618-0056	Gusset, Extension	2
41	5040-0601	Guide, Circuit board 2-1/2 in. lg	6
42	00618-0050	Deck, Voltage Regulator	1
43	3050-0226	Washer, 0.438 in. od, 0.195 in. id, ss	4

REF.	STOCK NO.	DESCRIPTION	QTY.
44	1251-1037	Connector, 7 contact male cable plug	1
45	1251-1039	Ring, Lock	1
46	1251-1040	Spring, Lock	1
47	1251-1041	Hood, Insulating	1
48	1251-0194	Connector, 15 contact printed circuit type	3
53	00618-031	Gusset, Right	1
54	00618-0053	Gusset, Left	1
55	2520-0017	Screw, Round head ss, 6-32 thd, 2-3/4 in. lg	1
56	3050-0071	Washer, no. 8, 7/16 in. od, cad pl brass	2
57	3050-0006	Washer, no. 10, 1/2 in. od, fibre	2
58	2190-0017	Washer, Split lock for no. 8 screw	1
59	2580-0004	Nut, 8-32 thd x 11/32 in. ss	1
60	3050-0019	Washer, no. 10, 1/2 in. od, nickel pl brass	4
61	2980-0001	Nut, 10-24 thd x 3/8 in. ss	4
62	2950-0038	Nut, 1/2-24 thd x 11/16 in., cad pl s	2
63	2190-0037	Washer, Int lock for 1/2 in. screw	2
64	0900-0016	O-ring, Rubber 1/2 in. id, 11/16 in. od	1

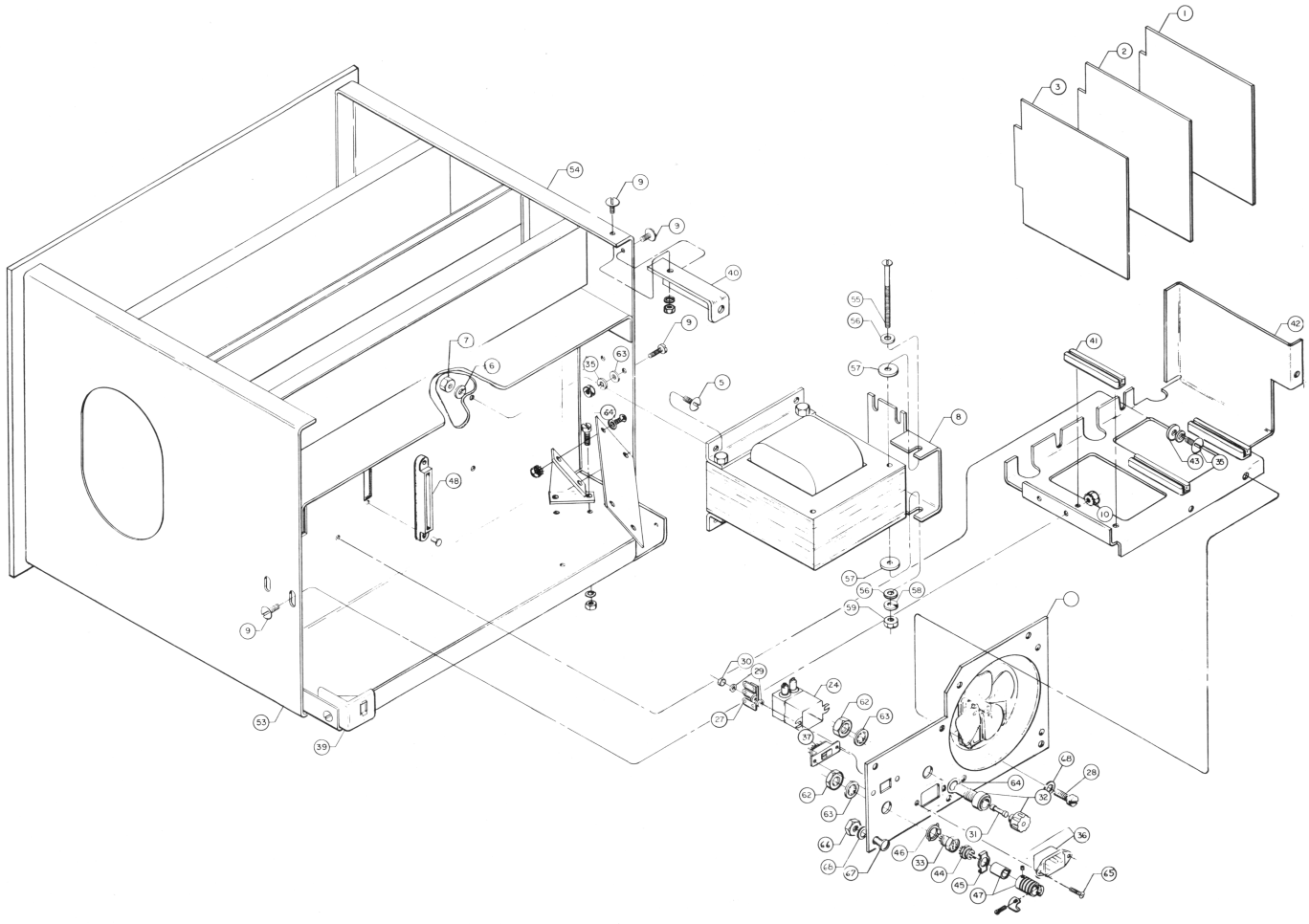

Figure I-14. HP Model 618C/620B S.H.F. Signal Generator, Chassis, Rear View

Parts List for Figure I-15

REF.	STOCK NO.	DESCRIPTION	QTY.
1	00618-6056	Cabinet Assembly	1
	00618-6063	Cabinet Assembly, Rack	1
2	5020-7433	Captive Screw Assy (Cabinet Model only)	4
2	3150-0005	Filter, Air	1
3	2940-0039	Screw, Pozidrive 1/4 x 20, 3/4" lg (Rack Models only)	4

REF.	STOCK NO.	DESCRIPTION	QTY.

REF.	STOCK NO.	DESCRIPTION	QTY.

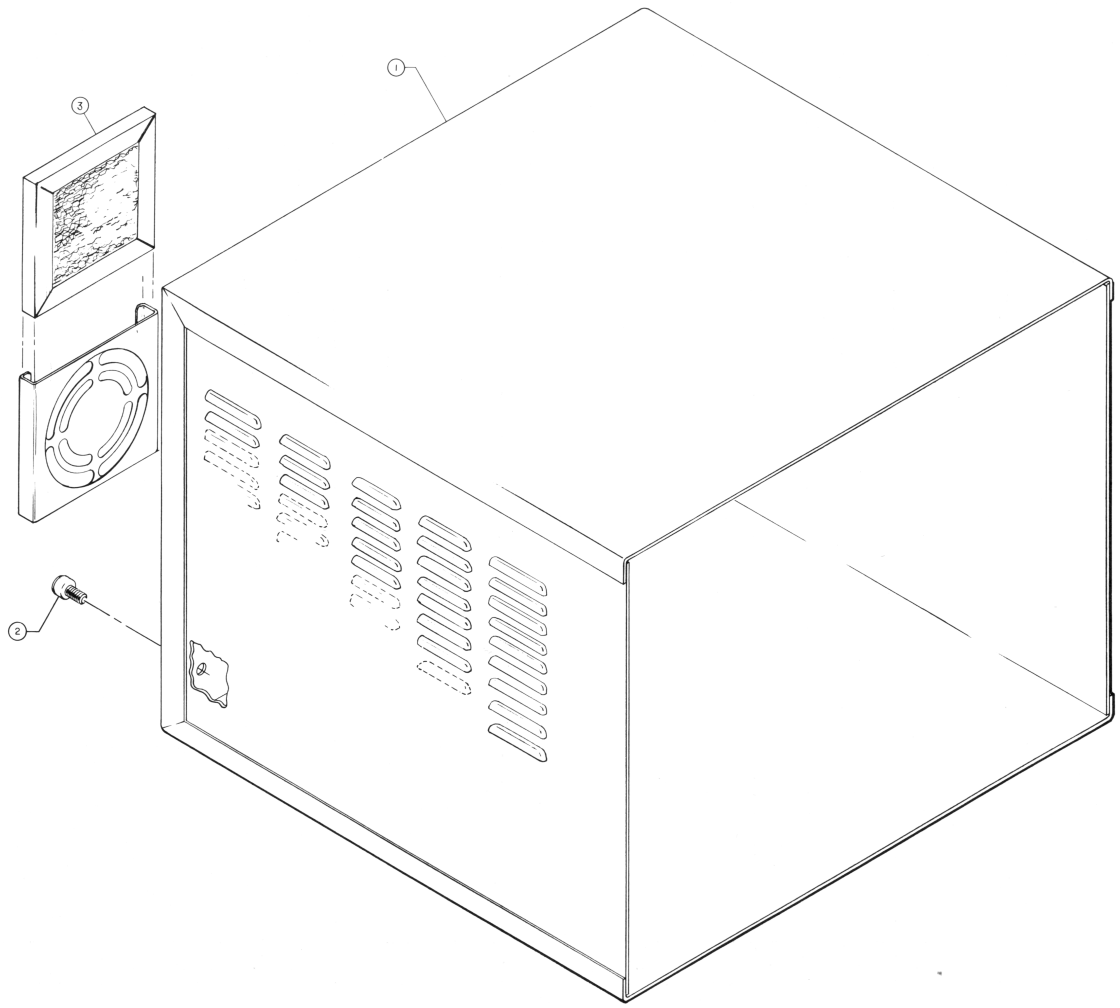

Figure I-15. HP Model 618C/620B S.H.F. Signal Generator, Dust Cover

APPENDIX II
BACKDATING

MANUAL CHANGES

MODELS 618C/620B
SHF SIGNAL GENERATOR

618C ONLY

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
630- below 00175	A thru K
645-00176 thru 645-00200	B thru K
702-00201 thru 702-00210	C thru K
702-00211 thru 702-00278	D thru K
716-00279 thru 740-00700	E thru K

SERIAL PREFIX OR NUMBER	MAKE MANUAL CHANGES
740-00701 thru 740-00725	F thru K
740-00726 thru 740-01250	G thru K
915-01251 thru 915-01375	H, I, J, K
934-01376 thru 934-01500	I, J, K
934-01501 thru 934-01525	J, K

620B ONLY

633- below 00150	A thru K
645-00151 thru 645-00175*	B thru K
645-00176 thru 645-00200**	D thru K
718-00201 thru 740-00625	E thru K

*Excluding 645-00156, 645-00163, and 645-00165.
**Including 645-00156, 645-00163, and 645-00165.

740-00626 thru 740-01025	G thru K
911-01026 thru 911-01150	H, I, J, K
935-01151 thru 935-01225	I, J, K
935-01226 thru 935-01250	J, K

CHANGE A: Figure 5-31 and Parts List:
Change R513 to 562K ohm, HP Part No. 0757-0790.

CHANGE B: Parts List:
Change S1 to HP Part No. 3101-0107.

CHANGE C: Parts List:
Change CR401 and CR402 to HP Part No. 1901-0036. However, HP Part No. 1901-0487 listed in Parts List is recommended replacement.

CHANGE D: Figure 5-31 and Parts List:
Change R360 to 18 ohm, 2W, HP Part No. 0693-1801.
Change R372 to 15K ohm, 2W, HP Part No. 0693-1531.

CHANGE E: Figure 5-31 and Parts List:
Change R374 to 1.21 Megohm, HP Part No. 0757-0871.

CHANGE F: Figure 5-28 and Parts List:
Delete asterisk (*) from R701.

CHANGE G: Figure 5-25:
Change to show round connecting pins on printed circuit boards instead of square ones.

CHANGE H: Figure 5-23:
Refer to Figure B-1 to show Kingman boards instead of presently used printed circuit boards.

CHANGE I: Parts List:
Change S1 to HP Part No. 3101-0100.

CHANGE J: Parts List:
Change F101 (115V) to 3 amp, slo-blo, HP Part No. 2110-0029.
Change F101 (230V) to 1.5 amp, slo-blo, HP Part No. 2110-0338.
Change FL301 to HP Part No. 9110-0014.
Change J301 to HP Part No. 1251-0148.
Change S306 to HP Part No. 3101-0033.
Change Detachable Power Cord to HP Part No. 8120-0078.

CHANGE K: Delete diode CR103 connected from repeller of V114 to −1000V at R177.

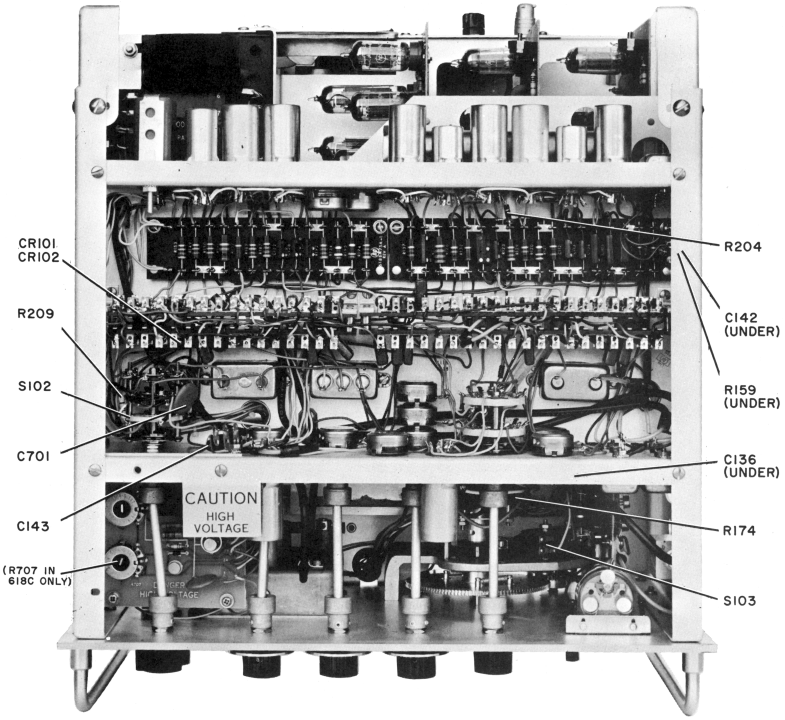

Figure II-1. Interior View Showing Locations of Unlabeled Chassis Components (Top View), Serial Numbers 915-01375 and below (618C only) and 911-01150 and below (620B only).

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